RABBIT MINE

Wallowa-Whitman National Forest
Grant County, Oregon

SITE INSPECTION

February 6, 2009

Prepared For:
USDA Forest Service
Gifford Pinchot National Forest
10600 NE 51st Circle
Vancouver, WA 98682

MSE
Millennium Science & Engineering, Inc.

SITE INSPECTION REPORT

Rabbit Mine
Wallowa-Whitman National Forest, Oregon — February 2009

Principal Author: Michael J. Puett, P.E.
Project Manager

Reviewed By: Leslie Eldridge, P.E.
Technical Reviewer

Prepared For: USDA Forest Service
Gifford Pinchot National Forest
10600 NE 51st Circle
Vancouver, WA 98682

Prepared By: Millennium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
(208) 345-8292

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ACRONYMS AND ABBREVIATIONS

%R	Percent recovery
bcy	Bank cubic yard
$CaCO_3$	Calcium carbonate
gpm	Gallon per minute
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
sf	Square feet
ABA	Acid Base Accounting
AGP	Acid Generating Potential
amsl	Above mean sea level
ANP	Acid Neutralizing Potential
APA	Abbreviated Preliminary Assessment
AWQC	Ambient water quality criteria
bgs	Below ground surface
BLM	United States Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
COI	Contaminant of interest
COPC	Contaminant of potential concern
CPEC	Contaminant of potential ecological concern
CTE	Central tendency exposure
DO	Dissolved oxygen
Eco-SSL	Ecological Soil Screening Level
ECR	Excess cancer risk
EE/CA	Engineering Evaluation/Cost Analysis
Eh	Electrical conductivity
EPA	United States Environmental Protection Agency
ERA	Ecological risk assessment
FR	Forest Road
FWS	U.S. Fish and Wildlife Service
GPS	Global positioning system
HHRA	Human health risk assessment
HI	Hazard index
HUC	Hydrologic unit code
LCS/LCSD	Laboratory control sample/ laboratory control sample duplicate
MCL	Maximum contaminant level
MDC	Maximum detected concentration
MS/MSD	Matrix spike/matrix spike duplicate

ACRONYMS AND ABBREVIATIONS (Continued)

MSE	Millennium Science and Engineering, Inc.
NFS	National Forest System
NNP	Net Neutralization Potential
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODGMI	Oregon Department of Geology and Mineral Industries
ORP	Oxygen reduction potential
PEL	Probable effects level
PRG	Preliminary Remediation Goal
QA	Quality assurance
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RL	Reporting limit
RMC	Risk Management Criteria
RME	Reasonable maximum exposure
RPD	Relative percent difference
SI	Site Inspection
SLV	Screening level value
SOC	Species of concern
SPLP	Synthetic Precipitation Leaching Procedure
SVL	SVL Analytical Laboratory
T&E	Threatened and endangered
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total dissolved solids
TEL	Threshold effects level
TOC	Total organic carbon
TOM	Total organic matter
TRV	Toxicity reference value
UCL_{90}	90 percent upper confidence limit
USGS	United States Geological Survey
WAD	Weak acid dissociable
WRCC	Western Regional Climate Center
XRF	X-Ray Fluorescence

EXECUTIVE SUMMARY

- The Rabbit Mine is an inactive gold mine and millsite, located about 8 miles southwest of Granite, Oregon in the Wallowa-Whitman National Forest.
- Under contract to the USDA Forest Service (Forest Service), Millennium Science and Engineering, Inc. (MSE) completed a Site Inspection (SI) of the Rabbit Mine (Site) to:
  - Characterize site features and physical hazards;
  - Assess potential risks to human and ecological receptors at the Site from exposure to mine wastes;
  - Estimate mine waste quantities; and
  - Determine background soil concentrations.
- This report describes the SI field investigation activities and summarizes analytical results, mine waste volume estimates, a physical hazards assessment, and streamlined human health and ecological risk assessments.
- Site features at the Rabbit Mine include:
  - Burned remnants of a wooden mill foundation
  - Two open shafts
  - One collapsed adit
  - One small pond
  - Two waste rock piles
  - Placer deposits
  - Log cabin
- A total of 34 samples were collected from the background soils, mine waste (waste rock and placer deposits), sediment, surface water, pore water, and benthic macroinvertebrates.
  - Analytical results of the samples indicate elevated concentrations of several metals, particularly arsenic, in the mine waste.
  - Metals concentrations in the sediment samples were significantly lower and only a few metals were detected in the surface water samples.
  - Potential acid generation in the mine waste is very low, and there is no obvious evidence of contaminant migration from the Site.
- Streamlined human health and ecological risk assessments for the following pathways were completed to assess potential risks to human and ecological receptors at the Site.
  - **Groundwater Pathway:** The groundwater pathway is incomplete because there is no drinking water source at the Site and no wells within a 1-mile radius.
  - **Surface Water Pathway:** The surface water pathway is complete for human receptors but insignificant because of the low metals concentrations; however, the pathway is complete and significant for ecological receptors because of elevated metals concentrations in the sediments.
  - **Soil Pathway:** The soil pathway is complete and significant for both human and ecological receptors because of elevated metals concentrations in the mine wastes.
  - **Air Pathway:** The air pathway is complete for human receptors but insignificant because of extremely low risk levels.
- Results of the streamlined human health risk assessment (HHRA) indicate risk from exposure to metals in mine wastes at the Site.
  - The most significant exposure pathway is ingestion of and dermal contact with the mine waste. There is also moderate risk to the adult worker from dermal contact with sediment.
  - Inhalation of particulates from the mine waste, and ingestion of and dermal contact with surface water contribute minimal risk and are insignificant pathways.
  - Two human health contaminants of potential concern (COPC) were identified: arsenic and iron.

- Non-carcinogenic hazards were below the acceptable level for all receptors under both the central tendency exposure (CTE) scenario and the reasonable maximum exposure (RME) scenario.
- There is moderate carcinogenic risk to all receptors under the RME scenario from exposure to arsenic in the mine waste, and low carcinogenic risk to the adult worker from exposure to arsenic in the sediment. Under the CTE scenario, carcinogenic risks were below the acceptable level for all receptors.
- Risk-based hot spot concentrations and cleanup levels for arsenic in mine waste and sediment were back calculated using risk equations from the streamlined HHRA.
  - No areas exceeded the sediment hot spot arsenic concentration of 1,160 milligrams per kilogram (mg/kg), or sediment arsenic cleanup level of 116 mg/kg.
  - One area exceeded the soil hot spot concentration of 460 mg/kg:
    - Waste rock pile WR1 = 1,280 mg/kg
  - Two areas exceeded the arsenic cleanup level of 46 mg/kg:
    - Waste rock pile WR1 = 1,280 mg/kg
    - Soil around the mill foundation = 69.1 mg/kg
    - Total estimated volume of mine waste above the cleanup level = 3,070 bank cubic yards (bcy)
- Lead risks were not quantified because of the lack of established toxicological data and the limitations of current lead exposure models; however, the maximum detected lead concentration (194 mg/kg) at the Site is well below Oregon state and federal human health screening criteria. Therefore, lead does not appear to pose a human health risk at the Site.

- Results of the streamlined ecological risk assessment (ERA) indicate potential risk to ecological receptors at the Site from exposure to metals in mine waste and sediment; however, the risks are at the individual level rather than the population level. While individual receptors may be exposed to metals in mine wastes at the Site, their populations are unlikely to be significantly impacted because it is improbable that entire populations of receptors reside strictly within the bounds of the Site.
  - Several contaminants of potential ecological concern (CPEC) were identified, most notably iron, mercury cadmium, and zinc.
  - The highest risk ratios are from exposure to the mine waste; there is limited risk to individual aquatic receptors from exposure to metals in sediment.
  - There appears to be very limited ecological risk from exposure to surface water or pore water at the Site.
- There is no documented evidence of sensitive or threatened and endangered (T&E) species at the Site and none were observed during the field investigation by MSE in June 2008.
  - However, the Wallowa-Whitman National Forest is listed as providing habitat for several T&E species, including the bald eagle and Canada lynx.
  - Although these animals may occasionally traverse the Site, it is unlikely that their habitat would be limited to within the Site bounds.
- Significant physical hazards exist at the Site, including two open shafts and a collapsed adit.
- Based on the results of this SI and the streamlined HHRA, MSE recommends performing a streamlined Engineering Evaluation/Cost Analysis (EE/CA) to address physical hazards at the Site and potential human health risks from exposure to arsenic in the mine waste.

SITE INSPECTION DATA SUMMARY SHEET

Project Name: Rabbit Mine Site Inspection
Project Location: Section 10, Township 10 South, Range 35 East of the Willamette Meridian; Grant County, OR
Latitude: 44° 42' 42" N Longitude: 118° 28' 40" W Elevation: 6,030 feet amsl
Nearest Surface Water Body: Unnamed tributary to Olive Creek, flows through Site Area of Disturbance: Approximately 1 acre

SUMMARY OF SITE CHARACTERIZATION ANALYTICAL RESULTS

Medium	Volume/Rate of Discharge	Contaminant of Potential Concern[a]	Maximum Detected Concentration	Lowest Screening Criteria	Background Concentration[b]
Mine Waste	3,540 cubic yards	Arsenic	1,280 mg/kg	1.6 mg/kg – HH	3.4 mg/kg
		Cadmium	2.26 mg/kg	0.36 mg/kg – Eco	0.86 mg/kg
		Copper	118 mg/kg	50 mg/kg – Eco	35.3 mg/kg
		Iron	86,100 mg/kg	10 mg/kg – Eco	34,300 mg/kg
		Mercury	2.63 mg/kg	0.1 mg/kg – Eco	0.041 mg/kg
		Nickel	79.9 mg/kg	30 mg/kg – Eco	33.8 mg/kg
		Lead	57.0 mg/kg	11 mg/kg – Eco	4.88 mg/kg
		Antimony	14.2 mg/kg	0.27 mg/kg – Eco	4.2 mg/kg
		Zinc	270 mg/kg	50 mg/kg - Eco	45.0 mg/kg
Sediment	NA	Arsenic	52.1 mg/kg	5.9 mg/kg – Eco	Not measured
		Cadmium	0.22 mg/kg	0.003 mg/kg - Eco	Not measured
		Chromium	57.5 mg/kg	37 mg/kg - Eco	Not measured
		Copper	60.5 mg/kg	10 mg/kg – Eco	Not measured
		Nickel	37.7 mg/kg	18 mg/kg – Eco	Not measured
		Zinc	46.1 mg/kg	3 mg/kg - Eco	Not measured
Surface Water	6.2 gallons per minute discharge from the air shaft	Arsenic	3.85 µg/L	0.0022 µg/L - Eco	Not detected (<1.50 µg/L)
Pore Water	NA	None			

Notes:
[a]Only significant contaminants with concentrations above background and greater than 1.5x screening criteria are reported in this table.
[b]Background concentrations for mine waste based on 90 percent upper confidence limits (UCL_{90}) for background soil samples. If the UCL_{90} was above the maximum detected concentration (MDC), the MDC was used. No background samples were collected for sediment or pore water.
amsl = Above mean sea level
mg/kg = Milligram per kilogram
µg/L = Microgram per liter
Eco = Ecological; HH = Human health; NA = Not applicable

1.0 INTRODUCTION

- Millennium Science and Engineering, Inc. (MSE) was contracted by the USDA Forest Service (Forest Service) to perform a Site Inspection (SI) of the Rabbit Mine in the Wallowa-Whitman National Forest in Grant County, Oregon. Background samples consisted of:
  - Soil samples collected from four undisturbed areas around the perimeter of the Site, and
  - Surface water samples collected from the main shaft and air shaft.
  - No background sediment or pore water samples could be collected because of the lack of an upstream source in the drainage.
- This report describes the SI field investigation activities and summarizes analytical results, mine waste volume estimates, a physical hazards assessment, and streamlined human health and ecological risk assessments.
- The SI was performed in general accordance with the following U.S. Environmental Protection Agency (EPA) guidelines and state and federal regulations:
  - CERCLA;
  - SARA;
  - NCP 40CFR 300.415(b)(4)(i);
  - EPA's *"Guidance for Performing Site Inspections Under CERCLA"* (1992);
  - EPA's *"Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)"* (1991);
  - EPA's *"Risk Assessment Guidance for Superfund Volume II – Environmental Evaluation Manual"* (2001);
  - EPA's *"Risk Assessment Guidance for Superfund, Part E, Supplemental Guidance for Dermal Risk Assessment"* (2004a);
  - EPA's *"Region 10 Supplemental Ecological Risk Assessment Guidance for Superfund"* (1997a);
  - EPA's *"Exposure Factors Handbook"* (1997b);
  - Oregon Department of Environmental Quality's (ODEQ) *"Guidance for Conduct of Deterministic Human Health Risk Assessment"* (2000a);
  - ODEQ's *"Guidance for Ecological Risk Assessment"* (2001); and
  - Oregon Administrative Rules (OAR) 340-122-084, Sections 010 through 115 (ODEQ 2000b).

1.1 Purpose and Objectives

- The SI is a component of the Superfund Accelerated Cleanup Model, devised by EPA to meet the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, EPA 1992).
- The Rabbit Mine SI is intended to provide sufficient and appropriate information for: (1) assessing potential risks to human health and the environment, and (2) developing and evaluating potential removal action alternatives.
- Primary objectives of the Rabbit Mine SI were to:
  - Determine if a release has occurred;
  - Estimate the volume and extent of an existing or potential release;
  - Evaluate existing or potential impacts to terrestrial and aquatic habitats;
  - Evaluate existing or potential risk to human and ecological receptors and, if necessary, establish appropriate risk-based, site-specific, clean up levels; and
  - Estimate 90 percent Upper Confidence Limits (UCL_{90}) for background concentrations.

1.2 Site Description

- The Rabbit Mine is an inactive gold mine and millsite located about 8 aerial miles southwest of Granite, Oregon (Figure 1).
- The historic mining town of Greenhorn is less than 1 mile southwest of the Site. Greenhorn reportedly has a population of 2 along with a small populace of seasonal inhabitants and visitors (Cockle 2008).
- The Site location is described as:
  - Southeast quarter of Section 10, Township 10 South, Range 35 East of the Willamette Meridian;
  - Latitude = 44° 42' 42"N;
  - Longitude = 118° 28' 40"W; and
  - Elevation = 6,030 feet above mean sea level (amsl).
- Access to the Site is from State Route 7 by traveling north on Greenhorn Road (County Route 503) along the North Fork Burnt River for 8.7 miles. Turn right on Forest Road (FR) 920 (unmarked) and proceed 0.5 miles east to the Site.
- The Site is located near the top of a small drainage.
  - There are no stream flows in the drainage above the Site but water seasonally discharges from a flooded air shaft.
    - During drier conditions, water does not discharge from the air shaft but emanates as a seep between the waste rock piles approximately 100 feet from the air shaft.
  - During the field investigation in June 2008 by MSE, the flow in the stream ranged from 6.2 gallons per minute (gpm) discharging from the air shaft to 27 gpm at the lower end of the Site.
  - The flow eventually discharges to Olive Creek, about 1,000 feet downstream of the Site.
- Site features include:
  - Open main shaft
  - Flooded air shaft
  - One collapsed adit
  - Two waste rock piles
  - Placer deposits
  - Small pond
  - Log cabin
  - Burned remnants of a wooden mill foundation
  - Several empty 55-gallon drums and miscellaneous wood and metal debris
- The total estimated volume of mine waste at the Site is 3,540 bank cubic yards (bcy):
  - The estimated volume of waste rock is 3,050 bcy.
    - Waste rock pile WR1 = 2,470 bcy
    - Waste rock pile WR2 = 570 bcy
    - Waste rock around the pond = 10 bcy
  - The estimated volume of metals-contaminated soil around the mill foundation is 320 bcy.
  - The estimated volume of a large placer deposit in the intermittent stream channel below the mill is 170 bcy.
  - The estimated volumes do not account for potential contamination of the underlying soil or creep (i.e. migration of the waste material from gravity, erosion, or other means).
- A work camp with several cabins and other wooden structures is located approximately 400 feet north of the Site.

    - The work camp appears to have supported several mines in the area and was not considered to be part of the Rabbit Mine Site.
    - A description of the work camp and environmental concerns identified during the June 2008 field investigation by MSE is provided in an Addendum at the end of this report.
- A more detailed description of the Site is provided in Section 2.1.

1.2.1 Climate

- Available climate data for the Site was obtained from the Western Regional Climate Center (WRCC) website (2008).
- The nearest climate station is located in Granite, Oregon (8 miles northeast of the Site) at an elevation of 4,940 feet amsl.
- Because the Site is significantly higher in elevation than the nearest climate station (at 6,020 feet amsl), it likely receives significantly more precipitation and has lower maximum and minimum temperatures.
- Climate data from the Granite station is presented in Table 1 and summarized below:
    - Total average precipitation = 26.4 inches per year
    - Total average snowfall = 174 inches per year
    - Mean minimum temperature = 26.2° F
    - Mean maximum temperature = 52.6° F

1.2.2 Regional Geology

- The Site is located in the Blue Mountain physiographic province of northeastern Oregon.
    - The Blue Mountains are characterized by a complex assemblage of distinct exotic terranes that were accreted on the western coast of the North American craton during the Triassic and Jurassic. Each of these terranes consists of a distinctive suite of volcanic, sedimentary and metamorphic rocks with later intrusive granitic bodies (Orr and others 1992).
    - The Site is located within the Baker Terrane, which forms the core of the Greenhorn Mountains characterized by narrow valleys with glaciated peaks up to approximately 8,000 feet amsl.
    - The Baker Terrane is composed of several formations beginning with the Permian Burnt River schist, which is overlain by the Triassic Elkhorn Ridge argillite.
        - During the Cretaceous period, these units were intruded by granitic batholiths of granodiorite and gabbro (Orr and others 1992; Oregon Department of Geology and Mineral Industries [ODGMI] 1976). The contact between the native rock and the intrusive bodies was the primary zone of mineralization that was the target of area hardrock mines.
        - During the Tertiary period, the area was subject to intense volcanism that covered much of the region with widespread lava and ash deposits (Orr and others 1992).
        - During the Pliestocene period, the mountainous regions were subject to alpine glaciation.
- Available information from regional mining reports indicates that the Rabbit Mine targeted a mineralized vein within granodiorite. The vein strikes north 10° east, and dips 70° east (ODGMI 1941 & 1968).

1.2.3 Hydrogeology

- Hydrogeologic information for the Site was based primarily on visual inspection of the Site and area well logs.

- The Site is located in a bedrock unit (granodiorite) that generally exhibits low permeability.
- Although no drinking water wells appear to be located near the Site, bedrock does provide a source of groundwater in the region.
- Review of well logs located in Section 22 and 21 (T10S, R35E) indicate a low yielding fractured bedrock aquifer with typical well production rates of 2 to 4 gpm.
  - According to the well logs, these wells were typically completed within granite or basalt with groundwater first encountered approximately 90 to 120 feet below ground surface (bgs).
- Bedrock typically exhibits low permeability, unless the unit has been fractured through folds, faulting, drilling, or mining practices.
- The connection between the fractured bedrock aquifer and area surface water is unknown; however, springs are present in the general area.

1.2.4 Hydrology

- The Site is located near the top of a small drainage that ranges in elevation from 5,800 to 6,200 feet amsl.
- Shallow groundwater and seasonal springs form an unnamed, first order, intermittent tributary to Olive Creek. Snow melt and run off are the primary contributors to stream flows in the area because of higher elevations in the surrounding hills.
- During the field investigation by MSE in June 2008, groundwater emanating from the flooded air shaft formed the headwaters of the stream; however, during a site reconnaissance in October 2007, the stream was dry, except for isolated seeps that only flowed short distances before infiltrating.
- The following is a U.S. Geological Survey (USGS 2008) hydrologic unit code (HUC) description of the stream watershed relationships:
  - Stream Order:
    →Olive Creek
      →Clear Creek
        →Granite Creek
          →North Fork John Day River
            →John Day River
              →Columbia River
  - Watershed Association:
    →Beaver Creek - Subwatershed
      →Granite Creek - Watershed
        →North Fork John Day - Subbasin
          →John Day - Basin
            →Middle Columbia - Subregion
              →Pacific Northwest - Region

1.2.5 Wetlands

- Wetlands information was retrieved from the U.S. Fish and Wildlife Service (FWS) National Wetlands Inventory using the wetland online mapper at http://wetlandsfws.er.usgs.gov. There were no identified, or observed, wetlands on or near the Site.
- A mature riparian habitat is present along the intermittent stream and is comprised of dense willow and alder thickets with birch and isolated conifers dominating the riparian canopy.
- Further removed from the bank, the drainage is surrounded by a mature Grand Fir/Pinegrass plant association (Johnson 2004).

1.2.6 Terrestrial Habitat

- The Site is located in the Wallowa-Whitman National Forest within the Blue Mountains Ecoregion.
- Terrestrial habitats in the vicinity are dominated by a Grand Fir/Pinegrass plant association as defined in *"Alpine and Subalpine Vegetation of the Wallowa, Seven Devils and Blue Mountains"* (Johnson 2004).
  - This plant association is found along convex and concave slopes (between 20 to 50 percent) on basaltic substrates at elevations ranging from 5,780 to 6,690 feet amsl.
- Common soil characteristics include thick volcanic ash with a stony colluvium layer derived from weathered bedrock.
  - These soils tend to have a high available water capacity.
  - An average profile would be approximately 17 inches of silt loam above a very stony silt loam and sand loam to 42 inches.
- The typical vegetation composition for this type of habitat is commonly comprised of early to mid seral stands, dominated by Douglas Fir and Grand Fir.
  - Western larch and lodgepole pine are often components of the understory and overstory.
  - These early and mid seral stands consist of Grand Fir trees averaging 120 years old and Douglas Fir trees averaging 145 years old.
- The understory consists mainly of Pinegrass and heartleaf arnica with low coverages of birchleaf spiraea and creeping Oregon grape.
  - Sweet cicely, bigleave sandwort, white hawkweed, Piper's anemone, and woods strawberry are common but not dominant.
  - These habitats consist of soils that drain quickly and are not ideal for shrub community dominance.
- A list of plants and animals known to inhabit North Fork John Day Watershed are identified by the Oregon Department of Fish and Wildlife (ODFW) and included in Appendix A (ODFW 2008).

1.2.7 Threatened and Endangered Species

- Information regarding threatened and endangered (T&E) species and species of concern (SOC) for wildlife and plant species occurring in the Blue Mountains Ecoregion was obtained from the ODFW (ODFW 2008) and the Oregon Natural Heritage Program (ONHP 2007) and are listed in Appendix A.
- Federally listed T&E, proposed, candidate species and SOC within the Wallowa-Whitman National Forest and specifically Grant County are also listed in Appendix A.
- There are no T&E species documented as inhabiting the Site and none were observed at the Site during the field investigation by MSE in June 2008, or during the site reconnaissance by MSE in October 2007.
- Federally listed T&E species which may occur within Grant County, Oregon include:
  - Canada lynx (Felis lynx Canadensis)
  - Bald eagle (Haliaeetus leucocephalus)
  - Steelhead, Middle Columbia River (Oncorhynchus mykiss ssp.)
  - Bull trout, Columbia River Basin (Salvelinus confluentus)

1.3 Operational History

- Information regarding the operational history of the Rabbit Mine is very limited. The available information is summarized below.
  - The Site was discovered in 1925 and produced $40,000 prior to 1940 with a five-stamp mill (Forest Service 2004).
  - Reported owners in 1941 were L.A. Woodward of Baker, Oregon, and William Hay and Bennett James of Whitney, Oregon (ODGMI 1941).
  - There were six unpatented claims for the area in 1941 (ODGMI 1941).
  - The Site is developed with 1,000 feet of adits and a 160-foot shaft with drifts (ODGMI 1941).

1.4 Previous Investigations

- An Abbreviated Preliminary Assessment (APA) of the Site was completed by the Forest Service in March 2004.
- A portable X-ray fluorescence (XRF) analyzer was used to measure in-situ metals concentrations in mine waste piles at the Site.
  - Arsenic and chromium were the only contaminants of interest (COI) detected at concentrations exceeding EPA Region IX Industrial Soil Preliminary Remediation Goals (PRG, EPA 2004b).
  - The detection limit for some COIs may have been greater than the PRGs, resulting in false negatives.
- Based on the observed arsenic and chromium concentrations in the mine waste, as well as the physical hazards at the Site, the APA recommended an SI be completed.

2.0 FIELD INVESTIGATION

- MSE conducted a field investigation of the Rabbit Mine on June 19-20, 2008.
- Field investigation activities included:
  - Conducting a site reconnaissance to identify, inventory, and document the location and condition of mine waste sources and physical hazards
  - Completing a limited topographical survey of the Site
  - Collecting mine waste, background soil, surface water, pore water, sediment, and benthic macroinvertebrate samples
  - Completing an aquatic habitat survey
- Site photographs taken during the field investigation are provided in Appendix C.

2.1 Site Reconnaissance and Physical Hazards Survey

- Field staff inspected the Site and inventoried mine-related features, physical hazards, and other potential sources of contamination.
- Site features observed during the field investigation are shown on Figures 2 and 3.
- The access road to the Site (FR 920) is well traveled and easily accessible to a 4-wheel drive vehicle.
  - The access road leads to the main shaft and a large waste rock pile (WR1).
  - The road continues along a hillside adjacent to the Site, past a log cabin, and ends about 500 feet from the main shaft.
- The main waste rock pile (WR1) covers an area of about 11,700 square feet (sf) and appears to consist of coarse waste rock with finer material along the face and toe. There is a small section of

different colored, processed fine material (possibly tailings), on the toe of the pile near the intermittent stream channel.

- The main shaft is located in waste rock pile WR1. Depth to water in the shaft is about 12 feet.
- A small air shaft is located approximately 80 feet south of the main shaft and is about 10 feet lower in elevation. The air shaft was flooded during the field investigation and discharging water at about 6.2 gpm.
- The collapsed adit is about 60 feet south of the air shaft in a steep and narrow cut about 20 feet deep.
- A second waste rock pile (WR2) extends about 150 feet from the air shaft and covers an area of about 5,200 sf. The pile appears to be a mixture of waste rock and native overburden or road cut.
- Burned remnants of the wooden mill foundation are located on a bench below waste rock pile WR1. The bench is about 20 to 30 feet wide and 100 feet long, and covers an area of about 2,900 sf.
- The hillside below the mill area and along the drainage is heavily disturbed and appears to be a mix of waste rock and native soil.
- There are several small placer deposits in the drainage below the mill area and one large deposit that splits the stream channel and appears to be a mixture of coarse placer material and finer waste material. The large placer deposit is up to 6 feet thick and covers an area of about 2,400 sf.
- There is a small pond located on the north side of the drainage just downstream of the large placer deposit.
  - The pond is not hydrologically connected to the stream and appears to be seasonally filled with snow and rain.
  - The pond is 1 to 2 feet deep and covers an area of about 100 sf.
  - Earthen berms surrounding the pond appear to be a mixture of native soils and waste rock.
- No tailings deposits were identified in the drainage.
- Downstream of the Site, the stream flows through a culvert under a road approximately 600 feet from the mill area.
  - The flow increases significantly along the reach from 6.2 gpm at the air shaft to 27 gpm immediately upstream of the culvert.
  - Downstream of the road crossing, the stream flows through more placer deposits and eventually enters Olive Creek about 1,000 feet east of the Site
- Several empty 55-gallon drums and miscellaneous wood and metal debris are scattered on the Site and there are mining equipment parts on the main waste rock pile. Very little remains of the wooden mill foundation.
- Physical hazards at the Site pose a risk to the public and consist of the two open shafts and collapsed adit.
  - Both shafts currently have makeshift, temporary wooden covers that are easily removable.
  - The presence of shallow groundwater in both shafts poses a potential drowning hazard to humans or animals that could falling into the shafts if the covers were removed.
  - The collapsed adit is currently inaccessible; however, there is risk of falling rock from the surrounding highwalls and steep slope. Ore cart rails leading into the collapsed adit may invite excavation and re-exposure of the portal.
- A potential repository location and soil borrow source were identified on an open hillside about 300 feet west of the Site and adjacent to FR 943. The area covers about 1.5 acres and the slope ranges from 15 to 25 percent.
- A work camp with several cabins and other structures is located about 400 feet north of the mill area.

- The camp was not considered to be part of the Rabbit Mine Site and was not addressed in this SI. However, a description of the work camp and a discussion of potential environmental concerns identified at the camp are provided in an Addendum at the end of this report.

2.2 Site Mapping

- Cornerstone Surveying from John Day, Oregon was contracted to perform a limited topographical survey of the Site.
- Objectives of the survey were to collect sufficient topographic data points to:
  - Generate a 2-foot contour map of the Site,
  - Delineate waste areas,
  - Assist in estimating mine waste quantities, and
  - Identify key Site features and hazards.
- The survey did not include locating or surveying property boundaries.
- No benchmark could be found on the Site, so a global positioning system (GPS) instrument was used to establish a temporary benchmark on the Site near the main shaft. An iron pin was driven into the ground and the location was recorded as being at 6,035.8 feet amsl, 2,304.7 feet south, and 4,234.5 feet west of the SW corner of Section 10.

2.3 Mine Waste Volume Estimation

- The topography and dimensions of each mine waste pile were surveyed to assist in estimating mine waste volumes; however, the estimated volumes do not account for potential contamination of the underlying soils or "creep" (i.e. migration or spreading of the waste material via gravity, erosion, or other means). Therefore, the volumes listed below are estimates only and subject to verification.
  - The surface areas and estimated volumes of each mine waste pile are summarized in Table 2.
  - The estimated waste volumes are summarized below and were calculated by comparing an assumed underlying pre-mining topography to the existing topography using AutoCAD software:
    - The combined total estimated volume of mine waste at the Site is 3,540 bcy.
    - The estimated volume of waste rock is 3,050 bcy.
      - Waste rock pile WR1 = 2,470 bcy
      - Waste rock pile WR2 = 570 bcy
      - Waste rock around the pond = 10 bcy
    - The estimated volume of metals-contaminated soil around the mill foundation is 320 bcy.
    - The estimated volume of the large placer deposit in the intermittent stream channel below the mill site is 170 bcy. While several other placer piles were observed in the drainage below the mill site, this was the only pile that consisted of a mixture of significant fines with the coarse placer material; the other piles all consisted of large (~3 inch plus) placer material.
- The waste piles were inspected for evidence of flooding and erosion.
  - There is some evidence of minor erosion along the steep side slopes of waste rock piles WR1 and WR2, and fines eroding from the piles have migrated to the intermittent stream channel.
  - Water discharging from the air shaft flows between waste rock piles WR1 and WR2. A short section of metal pipe, approximately 20 feet long, conveys the flow under mine waste that has accumulated in the channel between the two waste rock piles.
  - With the exception of the placer deposit and waste rock around the pond, the waste rock piles and soil around the mill foundation are not subject to flooding or erosion from stream flows.

2.4 Sample Collection

- Samples of mine waste, background soil, surface water, sediment, pore water, and benthic macroinvertebrates were collected from the locations shown on Figure 2, and are summarized in Table 3.
- Background samples consisted of:
  - Soil samples collected from four undisturbed areas around the perimeter of the Site, and
  - Surface water samples collected from the main shaft and air shaft.
  - No background sediment or pore water samples could be collected because of the lack of an upstream source in the drainage.
- Characterization samples consisted of:
  - Mine waste samples collected from:
    - Waste rock piles WR1 and WR2
    - Soil around the mill foundation
    - Disturbed soils below the mill area
    - Waste rock around the pond
    - The placer deposit
  - Surface water, sediment, and pore water samples were co-located and collected from:
    - Intermittent stream at the toe of waste rock pile WR1
    - Pond
    - Intermittent stream immediately downstream of the Site
  - Benthic macroinvertebrate samples were collected from two reaches along the intermittent stream.
- The sampling methods and procedures used for each medium are described in the following sections.

2.4.1 Background Soil

- Background soil samples were collected from four areas (BG1 through BG4) near the mine that did not appear to have been disturbed by mining or other activities.
- The selected areas are expected to be representative of background conditions for the Site.
- One grab sample was collected from each location at a depth of 6 to 12 inches bgs utilizing disposable plastic hand trowels.
- The background soil sample locations are shown on Figure 3.

2.4.2 Mine Waste

- A total of 15 mine waste characterization samples were collected:
  - Six grab samples were collected from waste rock pile WR1 (WR1-RT-G-01 through WR6-RT-G-01),
  - Two grab samples were collected from waste rock pile WR2 (WR7-RT-G-01 and WR8-RT-G-01),
  - Three grab samples were collected from the mill area (WR9-RT-G-01 through WR11-RT-G-01),
  - One grab sample was collected from disturbed soils below the mill area (WR12-RT-G-01),
  - One grab sample and one composite sample were collected from the placer deposit in the drainage below the mill (WR13-RT-G-01 and WR14-RT-C-01), and
  - One composite sample from waste rock around the pond (WR15-RT-C-01).
- A duplicate mine waste sample was collected from waste rock pile WR1 (WR2-RT-G-02).

- The composite samples each consisted of four to six subsamples.
- The samples were all collected from depths ranging from 6 to 12 inches bgs using disposable plastic hand trowels and spoons
- The mine waste characterization sample locations are shown on Figure 2.

2.4.3 Surface Water

- A total of five surface water samples were collected:
  - Two background samples – one from the main shaft (SW5-RT-G-01) and one from the air shaft (SW4-RT-G-01)
  - One sample from the intermittent stream at the toe of waste rock pile WR1 (SW3-RT-G-01),
  - One sample from the pond (SW2-RT-G-01)
  - One sample from the intermittent stream immediately downstream of the Site (SW1-RT-G-01)
- A duplicate surface water sample was collected from the air shaft (SW2-RT-G-02).
- The samples were all collected directly from the source by submerging the laboratory-supplied sample bottle directly into the source. A sample was collected from the main shaft by tying a leader to the sample container, lowering it into the shaft, allowing it to gradually submerge and fill, and retrieving the filled container.
- Samples requiring dissolved analyses were filtered in the field using disposable Tygon® tubing, a peristaltic pump, and disposable 0.45-micron filters (filter area >600 square centimeters). New filters and tubing were used for each sample.
- Field parameters were measured during sample collection and included the parameters listed in Table 3.
- Stream flows were measured, where possible, using a timed-volumetric method.
- The surface water sample locations are shown on Figures 2 and 3.

2.4.4 Pore Water

- A total of three pore water samples were collected and co-located with the corresponding surface water samples:
  - One sample from the intermittent stream at the toe of waste rock pile WR1 (PW3-RT-G-01)
  - One sample from the pond (PW2-RT-G-01)
  - One sample from the intermittent stream immediately downstream of the Site (PW1-RT-G-01)
- The samples were collected immediately following collection of the surface water sample at each location.
- The samples were collected from the pore space in stream gravels in pool habitats where the substrate exceeded 6 inches depth.
- The samples were collected using a 27-inch stainless-steel pore water sampler. The sampler was inserted to a depth of about 6 inches into the substrate and a pore water sample was extracted using Tygon® tubing and a peristaltic pump.

2.4.5 Sediment

- A total of three sediment samples were collected and co-located with the corresponding surface water samples:
  - One sample from the intermittent stream at the toe of waste rock pile WR1 (SD3-RT-G-01)
  - One sample from the pond (SD2-RT-G-01)

- One sample from the intermittent stream immediately downstream of the Site (SD1-RT-G-01)
- The samples were collected immediately following collection of the pore water sample at each location.
- The samples were collected from 0 to 2 inches below the streambed and composited from two subsamples, one from pool and one from riffle habitat. Gravel and bits of vegetation were removed from the samples in the field and the lab was instructed to screen the sediment samples and discard material greater than 2 millimeters in diameter to focus the analysis on the finer material.

2.4.6 Aquatic Survey

- An aquatic survey was completed to assess potential impacts of the Site outflows on the instream habitat and benthic macroinvertebrate community.
- Two stream reaches, each approximately 75 feet in length, were established following EPA guidelines (Barbour et al. 1999).
  - An attempt was made to include both riffle and pool habitat within each reach, but the size and depth of the stream made this difficult.
  - Physical habitat quality was quantified for each reach using EPA's *"Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers – Habitat Assessment Field Data Sheets"* (Barbour et al.1999), and *"Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams"* (Plotnikoff and Wiseman 2001).
  - Quantitative and qualitative data on water chemistry and physical habitat were collected.
  - Water chemistry data were collected using a multi-parameter meter and included temperature, pH, specific conductivity (Eh), dissolved oxygen (DO) and oxidation reduction potential (ORP).

2.4.7 Benthic Macroinvertebrates

- Benthic macroinvertebrate samples were collected from the two aquatic survey reaches.
  - Two composite samples were collected from each reach, one from the downstream end and one from the upstream end. Collection of macroinvertebrate samples from specific habitats is necessitated by the potential of tailings mobilizing into the streams and settling in areas of slower moving water.
  - The samples were collected using a D-ring kick net.
  - Sampling techniques were in accordance with the *"Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams"* (Plotnikoff and Wiseman 2001).
  - The samples were stored in a solution of 85 percent ethanol and shipped to Aquatic Biology Associates, Inc. in Corvallis, Oregon for processing.

3.0 PHYSICAL HAZARD ASSESSMENT

- Physical hazards identified at the Site during the field investigation consist of the following:
  - Two open shafts
  - A collapsed adit

3.1 Open Shafts

- Two open shafts were identified during the field investigation. Both shafts are highly visible and easily accessible to the public.

- Main shaft:
  - Located above the mill on waste rock pile WR1.
  - Wooden, framed opening approximately 5 feet by 8 feet.
  - Depth to water approximately 12 feet bgs.
  - Has a makeshift, temporary wooden cover that is easily removable; however, shallow groundwater prevents access to the underground workings.
  - Potential drowning hazard to humans or animals that may fall into the shaft if the cover was removed.
- Air shaft:
  - Located outside the collapsed adit on waste rock pile WR2.
  - Wooden, framed opening approximately 2 feet by 4 feet.
  - Flooded and discharging water at an estimated rate of 6.2 gpm.
  - Has a makeshift, temporary wooden cover that is hinged and easily removable.
  - Small opening size minimizes drowning risk.

3.2 Collapsed Adit

- One collapsed adit was identified during the field investigation. The location of the collapsed adit was confirmed by the presence of iron rails leading into the area.
- The collapsed adit does not currently pose a significant hazard to the public, but may invite exploration or potential excavation of the area to expose the adit portal.
- The highwalls (~15 to 25 feet) and steep slope (40° to 60°) around the collapsed adit pose a potential risk from slope failure and falling rock.

4.0 ANALYTICAL RESULTS

- Solid and aqueous samples were submitted to SVL Analytical (SVL) in Kellogg, Idaho and the macroinvertebrate samples were submitted to Aquatic Biology Associates, Inc. in Corvallis, Oregon.
- Table 3 summarizes the samples collected and corresponding laboratory analyses.
  - Background soil sample analysis:
    - Paste pH
    - Selected metals typically found at mining sites in the region: antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc
    - Arsenic speciation (one sample representing 20 percent of the total number of samples)
  - Mine waste samples:
    - Paste pH
    - Selected metals: antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc
    - Total and weak acid dissociable (WAD) cyanide
    - Acid base accounting (ABA), sulfur forms, and metals by Synthetic Precipitation Leaching Procedure (SPLP) and Toxicity Characteristic Leaching Procedure (TCLP; only six samples representing 40 percent of the total number of samples)
    - Arsenic speciation (three samples representing 20 percent of the total number of samples)
  - Sediment samples:
    - Selected metals: antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc
    - Total and WAD cyanide

    - Total organic carbon (TOC) and total carbon content
    - Arsenic speciation (one sample representing 20 percent of the total number of samples)
  - Surface water samples:
    - Total metals: arsenic, chromium, mercury, and selenium
    - Dissolved metals: antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc
    - Total and WAD cyanide
    - TDS
    - Hardness, sulfate, and pH
    - Arsenic speciation (two samples only: 1 background sample and 1 characterization sample)
  - Pore water samples:
    - Total metals: arsenic, chromium, mercury, and selenium
    - Dissolved metals: antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc
    - Total and WAD cyanide
    - TDS
    - Hardness, sulfate, and pH
    - Arsenic speciation (one sample representing 20 percent of the total number of samples)
  - Benthic macroinvertebrate samples:
    - Taxonomy, generally to genus or species
- UCL_{90} concentrations were calculated using a spreadsheet developed by the ODEQ.
  - Available online at http://www.deq.state.or.us/lq/tanks/lust/upperconfidencelimit.htm.
  - Equations used in the spreadsheet are based on procedures described in EPA's *"Supplemental Guidance to RAGS: Calculating the Concentration Term"* (EPA 2002).
  - The program computes UCLs for each data set using several methods and recommends one based on the data distribution.
  - Data sets with fewer than 10 data samples can provide statistically unreliable estimates of the true average and the estimated UCL_{90} may occasionally exceed the maximum detected concentration (MDC). In those instances, the MDC was used in place of the UCL_{90}.

4.1 Background Soil

- Analytical results of the background soil samples are presented in Table 4.
  - Silver and selenium were not detected in the background soil samples, and cadmium was detected in only one sample.
    - While selenium was reported as not detected, the reporting limit (RL) for selenium was above the Oregon Level II Screening Level Value (SLV) for Plants, Invertebrates, and Wildlife (ODEQ 2001).
      - The RL is the lowest concentration at which an analyte can be detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision.
      - When the RL is above the SLV, a sample result reported as not detected (i.e. below the RL) may still be present at a concentration above the SLV but cannot be verified.
  - Several COIs in the background soil samples exceeded human health and/or ecological screening criteria:
    - The arsenic UCL_{90} exceeded the EPA Region IX Industrial Soil PRG (1.6 milligrams per kilogram [mg/kg], EPA 2004b) and the Oregon Industrial Maximum Allowable Soil Concentration Cleanup Level (3.0 mg/kg, ODEQ 2000b).

- The UCL_{90} for iron and nickel both exceeded SLVs (ODEQ 2001).
- The UCL_{90} for cadmium and antimony both exceeded EPA Ecological Soil Screening Levels (Eco-SSL, EPA 2005).

4.2 Mine Waste

- Analytical results of the mine waste samples are presented in Tables 5 and 6.
  - Cyanide, arsenic III and selenium were not detected in any of the mine waste samples; silver was detected in only one mine waste sample (WR5-RT-G-01).
  - Most COI concentrations were elevated above background levels when compared to background soil UCL_{90}.
  - Arsenic was the only COI that exceeded human health screening criteria.
    - Arsenic concentrations exceeded the EPA Region IX Industrial Soil PRG (1.6 mg/kg, EPA 2004b) and Oregon Industrial Maximum Allowable Soil Concentration Cleanup Level (3.0 mg/kg, ODEQ 2000b) in all 16 mine waste samples and ranged from 6.7 to 1,280 mg/kg.
  - Nearly all COIs exceeded one or more ODEQ and EPA ecological screening criteria.
    - Oregon Level II SLVs (ODEQ 2001):
      - All samples exceeded the copper, iron, nickel, and antimony SLVs.
      - Ten samples exceeded the mercury SLV.
      - Eight samples exceeded the zinc SLV.
      - Seven samples exceeded the lead SLV.
    - EPA Eco-SSLs (EPA 2005):
      - All samples exceeded the antimony Eco-SSL.
      - All but one sample exceeded the arsenic Eco-SSL.
      - Seven samples exceeded the cadmium Eco-SSL.
      - Six samples exceeded the lead Eco-SSL.
  - The highest concentration of most COIs was in samples from waste rock pile WR1.
  - The results for selenium were reported as not detected; however, the RL was above the SLV which means selenium may still be present at a concentration above the SLV but cannot be verified.
  - The TCLP and SPLP results are summarized in Table 6.
    - All results were well below the Resource Conservation and Recovery Act (RCRA) disposal limits which indicates that meteoric precipitation (i.e. rain and snow) that percolates through the mine waste is not likely to leach metals from the material and into groundwater.

4.3 Acid Base Accounting

- Results of the ABA analysis are summarized in Table 5.
- ABA testing predicts the potential for acid to be generated, based on the sulfur and carbonate content of the mineral (EPA 1994).
  - In ABA, a sample's Acid Generating Potential (AGP) is calculated from its pyritic sulfur (i.e., sulfide) content and the Acid Neutralization Potential (ANP) is measured from its ability to react with acid. The result is known as the Net Neutralization Potential (NNP) and is reported in tons of calcium carbonate ($CaCO_3$) per 1,000 tons of soil.
    - Negative NNP values indicate a risk of acid generation.
    - Values of NNP less than -20 indicate a material is likely to generate acid, and values greater than +20 indicate the material is unlikely to generate acid.

  - Values between -20 and +20 fall into a zone of uncertainty, and kinetic testing is required to predict acid generation potential.
  - ANP/AGP ratios greater than 3 represent a low risk, and ratios less than 1 represent a high risk of acid generation.
  - Ratios between 1 and 3 fall into a zone of uncertainty. It should be noted that the accuracy of ABA could be adversely affected by the presence of acid-producing sulfate minerals, iron or magnesium carbonates, or metals that form hydroxide precipitates.
  - In general, total sulfur content greater than 0.5 percent indicates risk of acid generation.
- To estimate the potential for acid generation from mine waste at the Site, ABA tests were conducted on six mine waste samples:
  - Three waste rock samples from WR1
  - One waste rock sample from WR2
  - One soil sample from the mill area
  - One soil sample from the placer deposit
- ABA results of the mine waste samples indicate a very low potential for acid generation in the mine waste at the Site.
  - NNP values ranged from 17.3 to 76.6, and the ANP/AGP ratios ranged from 116 to 511 indicating a very low risk of acid generation.
  - Mine waste pH was slightly alkaline and ranged from 7.07 to 8.47.
  - Sulfur was not detected any samples (i.e. <0. 01 percent), which indicates that acid generation is unlikely.

4.4 Sediment

- Analytical results of the sediment samples are presented in Table 7.
  - Cyanide, antimony and selenium were not detected in any of the samples; cadmium was detected in only one sample (SD3-RT-C).
  - Arsenic was the only COI to exceed human health screening criteria.
  - Several COIs exceeded ecological screening criteria:
    - Oregon Level II SLVs:
      - All samples exceeded SLVs for copper, nickel, and zinc.
      - One sample exceeded the cadmium SLV (SD3-RT-C).
      - Two samples exceeded the total chromium SLV (SD2-RT-C and SD3-RT-C).
    - NOAA Threshold Effects Levels (TEL), which is defined as the concentration below which adverse biological effects are not expected to occur (NOAA 1999).
      - All samples exceeded the arsenic, copper, and nickel TELs.
      - Two samples exceeded the chromium TEL (SD2-RT-C and SD3-RT-C).
    - NOAA Freshwater Probable Effects Levels (PEL), which is defined as the concentration above which adverse biological effects are frequently expected to occur (NOAA 1999).
      - Two samples exceeded the arsenic PEL (SD1-RT-C and SD3-RT-C).
      - One sample exceeded the nickel PEL (SD3-RT-C).
  - The highest concentration of COIs was in the sample from the intermittent stream immediately below WR1.
  - The results for arsenic III, cadmium, and selenium were reported as not detected; however, the RLs were above the SLVs which means the constituents may still be present at a concentration above the SLV but cannot be verified.
  - TOC ranged from 1.2 to 3.1 percent and total organic matter (TOM) ranged from 2.0 to 5.4 percent, which is generally consistent with small mountain streams.

4.5 Surface Water

- Analytical results of the surface water samples are presented in Table 8.
  - Besides the major cations (calcium, potassium, magnesium, and sodium), the only COI detected in the background samples was copper (only in sample SW5-RT-G-01 from the main shaft).
    - Background pH values were 6.59 (SW5-RT-G-01) and 7.44 (SW4-RT-G-01).
    - Background hardness values were 31.2 (SW5-RT-G-01) and 65.2 milligrams per liter (mg/L, SW4-RT-G-01) $CaCO_3$.
    - Background TDS concentrations were 55 (SW5-RT-G-01) and 78 mg/L (SW4-RT-G-01).
  - Besides the major cations, arsenic was the only COI detected in the two stream samples.
    - Arsenic V in sample SW3-RT-G-01, collected from the intermittent stream immediately below WR1, exceeded EPA's Recommended Chronic Ambient Water Quality Criteria (AWQC) for Protection of Aquatic Life.
    - Total arsenic in sample SW3-RT-G-01 also exceeded Oregon's Human Health Water Quality Criteria for Water and Fish Consumption (ODEQ 2005) and EPA's Recommended Chronic AWQC for Human Consumption of Water and Fish (EPA 2006).
    - pH values were 7.74 (SW1-RT-G-01) and 7.85 (SW3-RT-G-01).
    - Hardness values were 59.4 (SW1-RT-G-01) and 78.0 mg/L $CaCO_3$ (SW3-RT-G-01).
    - TDS concentrations were 80 (SW1-RT-G-01) and 94 mg/L (SW3-RT-G-01).
  - Besides the major cations, iron was the only COI detected in the pond sample and it was well below human health and ecological screening criteria.
    - The pH of the pond sample was 6.90.
    - The hardness of the pond sample was 54.7 mg/L $CaCO_3$.
    - The TDS in the pond sample was 78 mg/L.
  - Some results for arsenic and mercury were reported as not detected; however, the RLs were above the SLVs which means the constituents may still be present at a concentration above the SLV but cannot be verified.

4.6 Pore Water

- Analytical results of the pore water samples are summarized in Table 9.
  - No COIs exceeded screening criteria.
  - With the exception of the major cations (calcium, potassium, magnesium, and sodium), chromium and iron were the only COIs detected in pore water.
    - Chromium was detected in all three samples at concentrations well below screening criteria.
    - Iron was detected only in sample PW2-RT-G-01 and was well below screening criteria.
  - The results for mercury were reported as not detected; however, the RL was above Oregon's ecological screening criteria.
  - The pH values ranged from 6.87 to 7.80.
  - The hardness values ranged from 74.3 to 85.8 mg/L $CaCO_3$.
  - The TDS concentrations ranged from 80 to 96 mg/L.
  - Mercury was not detected; however, the RL was above Oregon ecological screening criteria. When the RL is above the SLV, sample results reported as not detected (i.e. below the RL) may actually be above the SLV but cannot be confirmed.

4.7 Aquatic Survey

- Results of the aquatic habitat assessment are summarized in Table 10.
- The intermittent stream flows through a basalt draw with an eastern aspect.
- The origin of flow and the surrounding geology create a high gradient intermittent stream that begins in a defined channel and becomes braided as the gradient decreases. It then rechannalizes as the gradient increases.
- Scientific reference data for intermittent, first-order stream habitats is very limited making it difficult to accurately assess aquatic habitat in the intermittent stream.
- Based on the size and length of the intermittent stream, two 75-foot long reaches were selected to define the aquatic ecology associated with the Site.
    - The two reaches were located at the proximal (upstream) and terminal (downstream) ends of the Site.
        - The upstream reach (BM1-RT) is located at the proximal end of the stream just downstream of the source at the flooded air shaft.
            - Stream flow starts at the flooded air shaft where the discharge is approximately 6.2 gpm.
            - The stream flows through a pipe that is under a waste rock pile associated with the mine. As the stream exits the pipe it flows approximately 100 feet and begins to braid.
            - The average stream width is 2 feet and the average depth is about 2 inches.
            - The stream morphology consists of 60 percent riffle, 30 percent pool and 10 percent run.
        - The downstream reach (BM2-RT) is located at the terminal end of the Site and is just upstream of a culvert that flows under a dirt road.
            - This reach is influenced by spring flow entering the stream just before the stream enters the culvert.
            - The average stream width is 2 feet and the average depth is about 2 inches.
            - The average flow was estimated to be 13.4 gpm.
            - The stream morphology consists of 20 percent riffle, 40 percent pool, and 40 percent run.
    - Aquatic vegetation was present on about 10 percent of both reaches and was a rooted submergent in reach BM1-RT gradually changing to a rooted emergent in reach BM2-RT.
    - There was no visible high water mark.
    - The stream was channelized with measurable woody debris.
    - The hyporheic zone consisted of primarily gravels with some cobbles and sands.
    - Coarse particulate organic matter was prevalent in about 30 percent of both reaches.
    - Both reaches were similar in ecological composition.
        - The riparian vegetation consists of primarily shrubs, specifically alders and willows, and was almost entirely shaded.
- Numeric habitat ratings were developed for each reach using EPA's *"Rapid Bioassessment Protocol – Habitat Assessment Field Data Sheets for High Gradient Streams"* (Barbour 1999).
    - Using this method, 10 instream and riparian habitat parameters are each scored separately and the individual habitat scores are summed to provide a habitat total score.
    - The individual habitat parameter scores were used to differentiate habitat quality between stream reaches. Additional instream characterization was conducted using a *"Physical Characterization Field Data Sheet"* (Barbour 1999).
        - Both reaches produced suboptimal habitat assessment scores.
            - The upstream reach (BM1-RT) produced a total score of 145.
            - The downstream reach (BM2-RT) produced a total habitat assessment score of 159.

- Water quality analyses of samples collected from both reaches indicate a water source that is healthy and functioning at or near its potential, and the aquatic habitat assessment indicates a stream ecology that is consistent with high elevation intermittent and spring fed streams.

4.8 Benthic Macroinvertebrates

- Results of the benthic macroinvertebrate sampling are summarized in Table 11.
- Sampling was done in accordance to the benthic sampling protocol set forth in EPA's *"Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition"* (Barbour 1999).
  - The Proportional-distance designation alternative for stream reach designation method was used at this Site in response to the size of the sampled stream.
  - Adaptations to the sampling method were done in accordance to site-specific constraints.
- The small, intermittent spring/stream channel at higher elevation is an atypical habitat.
  - The benthic community is simple; therefore, extensive data processing is not appropriate for this population.
  - A list of the taxa found and their abundances is provided in Table 11.
  - Benthic indices that are available to assess the data are more applicable to mid-order streams; therefore, it would not be appropriate to evaluate the data using these indices.
  - The stream originates from an overflowing mine shaft, so there is no possibility of locating a spatial control station upstream of the Site.
  - No benthic data are available from before the mine was developed, which precludes a control in time.
- This June 2008 data set forms a baseline from which trends in benthic invertebrate community structure and abundance can be followed in the future.
- Since this is a very atypical aquatic habitat for monitoring, and there is no comparative data from prior to mine development or from nearby reference sites, it was difficult to evaluate potential mine impacts to the benthic community at the Site. The following was determined by Robert W. Wisseman of Aquatic Biology Associates, Inc., Corvallis, Oregon:
  - Total invertebrate densities ranged from 18 to 73 invertebrates per 3.25 sf sample, which translates roughly to 6 to 22 per square meter. This is very low when compared with forested, montane, mid-order streams, which typically have densities ranging from 1,000 to 5,000 invertebrates per square meter.
  - Total taxa richness ranged from 5 to 9 taxa.
  - Many of the taxa present are cold-water biota or intolerant taxa, including Turbellaria (most are Polycelis, a montane, cold water genus), Pristinicola hemphilli, Baetis bicaudatus, Allomyia, Lepidostoma hoodi, Chyranda centralis and Prosimulium). The remaining taxa are cool water, montane stream associated.
  - Pristinicola hemphilli, Turbellaria (Polycelis) Lepidostoma hoodi and particularly Allomyia are taxa typical of springs and small spring channels. The remaining taxa may be found in both small and mid-size montane streams.
  - Allomyia and Pristinicola hemphilli are relatively rare taxa, but are not listed as Rare, Threatened or Endangered.
  - There is a dominance of Turbellaria in the samples from reach BM1-RT, and a dominance of the snail Pristinicola hemphilli in samples from reach BM2-RT.
  - Little is known of the specific tolerance to metals of the benthic invertebrate taxa present at these sites.
    - Mayflies are generally sensitive to a broad range of heavy metals.
    - Most snails are very sensitive to copper.
    - Caddisflies are generally not very sensitive to heavy metals.

4.9 Data Quality Review

- The analytical laboratory (SVL Analytical) conducted quality assurance (QA) consistent with the published methods, in accordance with their Quality Assurance Plans.
  - Internal QA procedures included the use of method blanks and laboratory control samples (LCS).
    - A method, or laboratory, blank is a sample of an uncontaminated reference matrix. The laboratory blank is analyzed to evaluate the accuracy of the analysis.
    - Laboratory control samples are evaluated to assess overall method performance and are the primary indicators of laboratory performance.
  - In addition, MSE submitted selected samples for matrix spike/matrix spike duplicate (MS/MSD) analysis.
    - In the MS/MSD analysis, the laboratory spikes two portions of the raw sample with a known amount of each analyte, then subjects the spiked and unspiked samples to the entire analytical procedure.
    - The percent recovery (%R) and relative percent difference (RPD) results from these samples allow an assessment of both accuracy and precision of the combined sampling/analytical system.
- MSE also collected two field duplicate samples and one field blank sample to externally estimate sampling and analytical precision.
  - The field duplicates were collected in the field at the same time and location as two other samples.
  - The field blank consisted of distilled, analyte-free water poured into laboratory-supplied samples containers in the field during sample collection.
- Review of SVL data quality:
  - Internal QA:
    - The concentrations of all analytes in each method blank were below the RLs, except for iron, which was detected at a concentration of 7.3 mg/kg in one of the blanks.
    - The reported %Rs and RPDs for all the laboratory control/laboratory duplicate samples (LCS/LCSD) pairs were within the laboratory QC limits except for calcium, ANP, and total sulfur, which were outside the RPD limits.
    - Results for the MS/MSD pairs showed recoveries outside of the acceptance limits for antimony, arsenic III, cyanide (total), iron, and zinc.
    - The sample holding time for the analysis of cyanide (total and WAD) was exceeded in all samples; however, as cyanide was not detected in any of the samples, MSE does not believe further sampling and analysis is necessary.
  - External QA:
    - A duplicate of a mine waste grab sample (WR2-RT-G-01) was collected and submitted to SVL for analysis.
      - The RPDs between concentrations of metals measured in grab soil sample WR2-RT-G-01 and duplicate sample WR2-RT-G-02 ranged from 0 to 62 percent.
    - A duplicate of a surface water sample (SW4-RT-G-01) was collected and submitted to SVL for analysis.
      - The RPDs between concentrations of metals measured in grab surface water sample SW4-RT-G-01 and duplicate sample SW4-RT-G-02 ranged from 0 to 8 percent.
  - Overall review of SVL's data quality results indicate that the analytical system was "in control" and that the reported concentrations are suitable for use in the SI and the streamlined risk assessments.

5.0 STREAMLINED RISK ASSESSMENT SUMMARY

- Streamlined human health and ecological risk assessments were completed for the Site and are provided in Appendix C and summarized in the following sections.
- The streamlined risk assessments focus on and evaluate only the principal exposure pathways and significant targets of concern. The objective is to determine whether sufficient risk is present to warrant a removal action.
- The streamlined process is intended to eliminate unnecessary data development and analysis, and reduce the overall effort and cost of the removal action. This approach recognizes that the elimination of all uncertainties is not possible or necessary, and uses only the data needed to generally characterize potential risks at the Site and support the development and selection of removal action alternatives.

5.1 Initial Risk Screening Summary

- The streamlined risk assessments included an initial risk screening as a very simplified risk evaluation to determine if further assessment was warranted. The initial screening involved comparing the maximum detected COI concentrations to U.S. Bureau of Land Management (BLM) Risk Management Criteria (RMC) for a preliminary qualitative assessment of potential risk to human and ecological receptors at the Site (Ford 2004).
  - The RMCs were developed as a screening tool for quickly assessing overall risks to humans and wildlife at abandoned mining sites from exposure to the most problematic metals (antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, silver, zinc) typically found at abandoned mine sites.
  - The human health RMCs for soil, sediment, and surface water are based on exposure scenarios that could potentially occur at abandoned mine sites, including camper, all-terrain vehicle driver, worker, surveyor, boater, swimmer, and resident. The camper scenario RMCs were used for the Rabbit Mine.
    - Arsenic was the only COI to exceed human health RMCs.
    - The initial risk screening results indicate a high risk to human receptors from exposure to arsenic in mine waste and a moderate risk from exposure to sediment at the Site.
    - There does not appear to be a human health risk from exposure to surface water at the Site.
  - The ecological RMCs were developed for soil from a survey of literature for toxicity data relevant to either wildlife receptors at BLM sites or to closely related species (Ford 2004).
    - The initial screening results indicate moderate to extremely high risk to all receptors from exposure to arsenic, cadmium, and lead in the mine waste.
    - Copper poses a moderate risk to the mule deer and a high risk to the robin.
    - Mercury poses a moderate risk to the deer mouse and robin, and zinc poses a moderate risk to the mule deer and robin.
    - There is also moderate risk to the robin from exposure to cadmium, copper and zinc in the background soil.

5.2 Human Health Risk Summary

- A streamlined human health risk assessment (HHRA) was conducted to assess and evaluate potential risks associated with exposure to mining-related contaminants at the Site (MSE 2008).
- The HHRA evaluated potential impacts to human health resulting from exposure to site-related contaminants of potential concern (COPC) in mine waste, sediment, and surface water at the Site.
- The results were used to identify areas and media posing significant risks to potential human receptors at the Site. Both reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios were evaluated.
- Two COPCs were identified: arsenic and iron. Arsenic (inorganic) is a carcinogen, and both arsenic and iron can pose non-carcinogenic health risks at high concentrations.
- The estimated non-carcinogenic hazards and carcinogenic risks from exposure to COPCs at the Site are summarized in Table 12.
  - The estimated non-carcinogenic hazards from exposure to iron and arsenic were compared to the EPA and Oregon acceptable hazard index (HI) of ≤ 1 (EPA 1991, ODEQ 2000a).
    - The results indicate minimal (i.e. HI ≤ 1) non-carcinogenic hazard for all receptors under both the CTE and RME scenarios.
  - The estimated carcinogenic risks from exposure to arsenic were compared with EPA's suggested screening ECR range of 1.E-06 to 1.E-04 (EPA 1991), and ODEQ's acceptable individual carcinogenic risk level of $\leq$ 1.E-06 (ODEQ 2000a).
    - The results indicate a very low carcinogenic risk (1.E-06) to the adult worker under the CTE scenario, and a moderate carcinogenic risk all receptors under the RME scenario.
    - The total cumulative ECR for both the child and adult recreationalist was 1.E-05 under the RME scenario.
    - The total cumulative ECR to the adult worker was 9.E-05 under the RME scenario.
  - Risks from exposure to lead cannot be quantified using standard risk assessment algorithms because the EPA has not established lead RfDs and SFs. Therefore, lead risks were qualitatively evaluated by comparing the maximum detected lead concentrations at the Site to EPA and Oregon State human health screening criteria.
    - The maximum detected lead concentration (194 mg/kg) at the Site is well below the EPA Industrial Soil PRG (800 mg/kg, EPA 2004b), and Oregon's Industrial Maximum Allowable Soil Concentration Cleanup Level (2,000 mg/kg, ODEQ 2000b).
    - There does not appear to be a human health risk from exposure to lead at the Site.
- Incidental ingestion of and dermal contact with arsenic in the mine waste are the most significant exposure pathways and contribute the majority of carcinogenic risk at the Site. There is also moderate carcinogenic risk to the adult worker from dermal contact with arsenic in the sediment.
  - Dermal contact with and incidental ingestion of surface water, and inhalation of particulates from the mine waste contributed minimally to the overall risk and, therefore, are not considered to be significant exposure pathways at the Site.

5.2.1 Hot Spot Assessment

- Hot spots are defined by Oregon's Environmental Cleanup Rules (OAR 340-122) as areas that present unacceptable risk and where contamination is "highly concentrated, highly mobile, or cannot be reliably contained."
  - "Highly concentrated" is defined as concentrations corresponding to a non-carcinogenic HQ of 10 or an ECR of 1E-04 (ODEQ 1998).
  - Hot spots often cover a relatively small area but contribute to a large percentage of the overall site contamination and exposure risk.

- Hot spot concentrations for arsenic in mine waste and sediment were back-calculated using the HHRA risk equations and an ECR of 1.E-04 and non-cancer HI of 10 for the most sensitive receptor (adult worker) under the RME scenario.
  - Soil arsenic hot spot concentration calculated to be 460 mg/kg
  - Sediment arsenic hot spot concentration = 1,160 mg/kg
- One area with arsenic concentrations greater than the calculated hot spot concentration was identified as a hot spot:
  - Waste rock pile WR1:
    - Sample WR5-RT-G-01 = 1,280 mg/kg
    - Sample WR6-RT-G-01 = 723 mg/kg
  - None of the sediment samples exceeded the arsenic hot spot concentration.
- Results of the hot spot assessment are summarized in Table 13.

5.2.2 Risk-based Cleanup Levels

- Because results of the HHRA indicated potential significant human health risks at the Site, risk-based cleanup levels were developed for arsenic in mine waste and sediment at the Site.
- The risk-based cleanup levels were back-calculated using the same equations and site-specific exposure factors used in the HHRA to calculate human health risks at the Site.
  - Risk equations for the most sensitive receptor (adult worker) under the RME scenario were used and an ECR of 1.E-05 was entered into the equations to back-calculate the corresponding maximum allowable arsenic concentration (i.e. cleanup level).
  - Soil arsenic cleanup level = 46 mg/kg
    - A total of seven mine waste samples from two different areas exceeded the soil cleanup level:
      - Waste rock pile WR1, maximum detected arsenic concentration = 1,280 mg/kg
      - Soil around the mill foundation, maximum detected arsenic concentration = 69.1 mg/kg
      - Estimated volume of mine waste above the cleanup level = 3,070 bcy
  - Sediment arsenic cleanup level = 116 mg/kg
    - No sediment samples exceeded the cleanup level.
- No cleanup levels were established for surface water because they typically default to state or federal water quality criteria, such as EPA maximum contaminant levels (MCL), and surface water does not pose a human health risk at the Site.
- Areas exceeding the cleanup levels are summarized in Table 13.

5.3 Ecological Risk Assessment Summary

- A screening level streamlined ecological risk assessment (ERA) was conducted to assess and evaluate potential ecological risks associated with exposure to mining-related contaminants at the Site. The ERA evaluated potential impacts to ecological receptors resulting from exposure to site-related contaminants in mine wastes, sediment, surface water, and pore water.
- The streamlined ERA involved identifying potential contaminants of ecological concern (CPEC) and calculating ecological risk ratios for ecological receptors in each medium. The risk ratios were then compared to receptor-specific risk ratios (Q-factors) to evaluate potential ecological risk.
- Risk ratios greater than 1 (Q > 1) indicate potential risk for protected (i.e., federally listed T&E species) while risk ratios greater than 5 (Q > 5) indicate potential risk to non-protected receptors. An acceptable risk ratio of 5 was used in this streamlined ERA because, although T&E species

have been identified in the Wallowa-Whitman National Forest, there appears to have been no documented occurrences at the Site and none were observed during the field investigation.

- COIs with risk ratios greater than 5 (Q > 5) were retained as CPECs. Several COIs also were retained because of the lack of established SLVs; the potential ecological risk posed by these CPECs, if any, cannot be quantified.
  - Five CPECs were identified with risk ratios greater than 5 (Q > 5): cadmium, copper, iron, mercury, and zinc.
  - Six additional CPECs were identified based on the lack of SLVs: antimony, arsenic V, arsenic total, chromium, copper, and silver.
- Results of the streamlined ERA indicate potential risk to ecological receptors at the Site and are summarized in Table 14.
  - Ecological risks from mine waste:
    - Iron poses a high risk to plants (Q = 8,610) and terrestrial invertebrates (Q = 431).
    - Mercury also poses a risk to plants (Q = 9) and terrestrial invertebrates (Q = 26).
    - Zinc poses a low risk to plants (Q = 5.4).
  - Ecological risks from sediment:
    - Cadmium, copper, and zinc pose a bioaccumulation risk to aquatic life (Q = 73, Q = 6, and Q = 15 respectively).
  - Risk ratios in surface water and pore water were all less than 5 (Q < 5).
  - Risk ratios for birds and mammals were all less than 5 (Q < 5).
  - Plants are the most susceptible ecological group with the highest risk ratios.
- Ecological risks appear to be limited to individual receptors and there does not appear to be any significant population-level risks.

6.0 CONCLUSION AND RECOMMENDATIONS

- Analytical results of samples collected during the field investigation indicate elevated concentrations of several metals in the mine waste.
  - Metals concentrations in the background soil and sediment samples were significantly lower and nearly all metals were undetected in the surface water samples.
  - Potential acid generation in the mine waste is very low.
- There is no obvious evidence of contaminant migration from the Site.
- Results of the streamlined HHRA indicate significant risk from exposure to arsenic in mine waste at the Site.
  - Two human health COPCs were identified: arsenic and iron.
  - Arsenic poses carcinogenic risk to the adult worker receptor under the CTE scenario, and to all three receptors under the RME scenario. Iron does not pose a significant human health risk.
  - The most significant exposure pathway is incidental ingestion of and dermal contact with the mine waste.
  - Inhalation of particulates from the mine waste, and ingestion of and dermal contact with surface water contribute minimal risk and are insignificant pathways.
- Results of the streamlined ERA indicate significant potential risk to ecological receptors at the Site; however, the risks are limited to individual receptors rather than at the population level.
  - Several CPECs were identified and the highest risk ratios are for metals in the mine waste, particularly iron, mercury and zinc.
  - There also appears to be limited bioaccumulation risk to individual aquatic receptors at the Site from exposure to metals concentrations in sediment, particularly cadmium, copper, and zinc.

- There does not appear to be a significant human health or ecological risk from exposure to surface water or pore water at the Site.
- Waste rock pile WR1 was identified as a hot spot, i.e., area that is highly contaminated and contributes to a large percentage of the overall exposure risk at the Site.
  - Two mine waste samples from the southeast face of the pile exceeded the arsenic hot spot concentration of 460 mg/kg.
  - The estimated volume of mine waste in WR1 is about 2,470 bcy.
- Risk-based cleanup criteria for arsenic in mine waste and sediment were back calculated using the risk equations and exposure factors used in the streamlined HHRA.
  - Based on the most sensitive receptor (adult worker) under the RME scenario and a cleanup carcinogenic risk level of 1.E-05 for total cumulative risk, the arsenic cleanup level is 46 mg/kg for soil and 116 mg/kg for sediment.
  - Seven mine waste/soil samples from two areas exceeded the arsenic cleanup level: waste rock pile WR1 and soil around the mill foundation.
  - The total volume of mine waste and soil exceeding the cleanup level is estimated to be 3,070 bcy.
  - No sediment samples exceeded the cleanup level.
- There are significant physical hazards at the Site, including the two open shafts and a collapsed adit. Measures should be taken to remove or mitigate physical hazards at the Site, particularly the open shafts.
- Based on the results of this SI, MSE recommends performing a streamlined Engineering Evaluation/Cost Analysis (EE/CA) to address physical hazards at the Site and arsenic concentrations in the mine waste.

DISCLAIMER

This abandoned mine/mill Site was created under the General Mining Law of 1872 and is located solely on National Forest System (NFS) lands administered by the Forest Service. The United States has taken the position and courts have held that the United States is not liable as an "owner" under CERCLA Section 107 for mine contamination left behind on NFS lands by miners operating under the 1872 mining law. Therefore, Forest Service believes that this Site should not be considered a "federal facility" within the meaning of CERCLA Section 120 and should not be listed on the Federal Agency Hazardous Waste Compliance Docket. Instead, this Site should be included on EPA' CERCLIS database. Consistent with the June 24, 2003 OECA/FFEO "Policy on Listing Mixed Ownership Mine or Mill Site Created as a Result of the General Mining Law of 1872 on the Federal Agency Hazardous Waste Compliance Docket," we respectfully request that the EPA Regional Docket Coordinator consult with the Forest Service and EPA Headquarters before making a determination to include this Site on the Federal Agency Hazardous Waste Compliance Docket.

Prepared by:

Millennium Science and Engineering, Inc.

2/6/09

Michael J. Puett, P.E.
Principal Author

2/6/09

Leslie Eldridge, P.E.
Technical Reviewer

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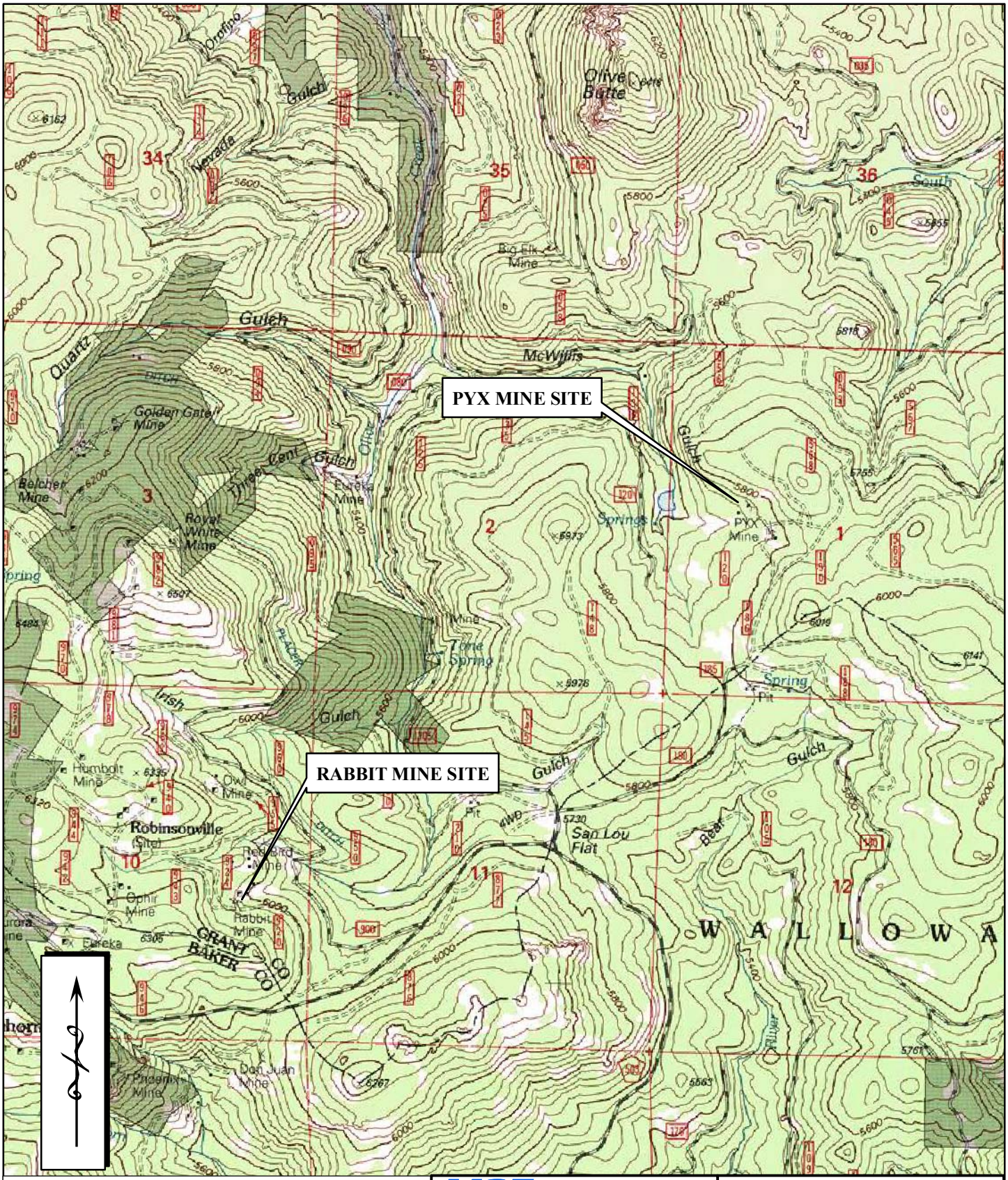
FIGURES



0 500 1,000 2,000 3,000 4,000 Feet

SCALE: 1 inch equals 2,000 feet

REFERENCE: U.S.G.S. 7.5 MINUTE QUADRANGLE, GREENHORN, OREGON 1995

MSE Millennium Science & Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, ID 83702 USA
Phone: (208) 345-8292

Rabbit Mine Vicinity Map

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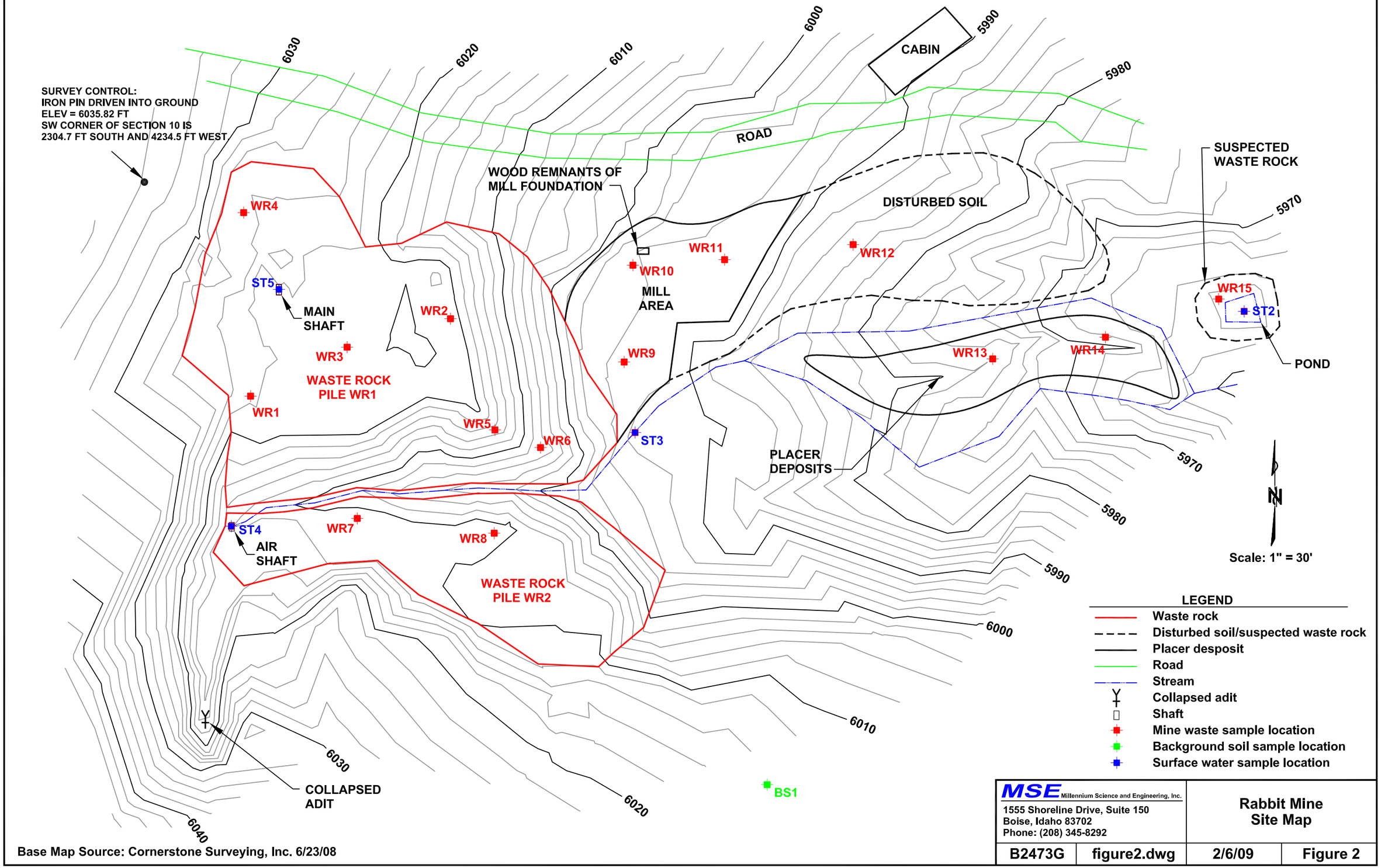
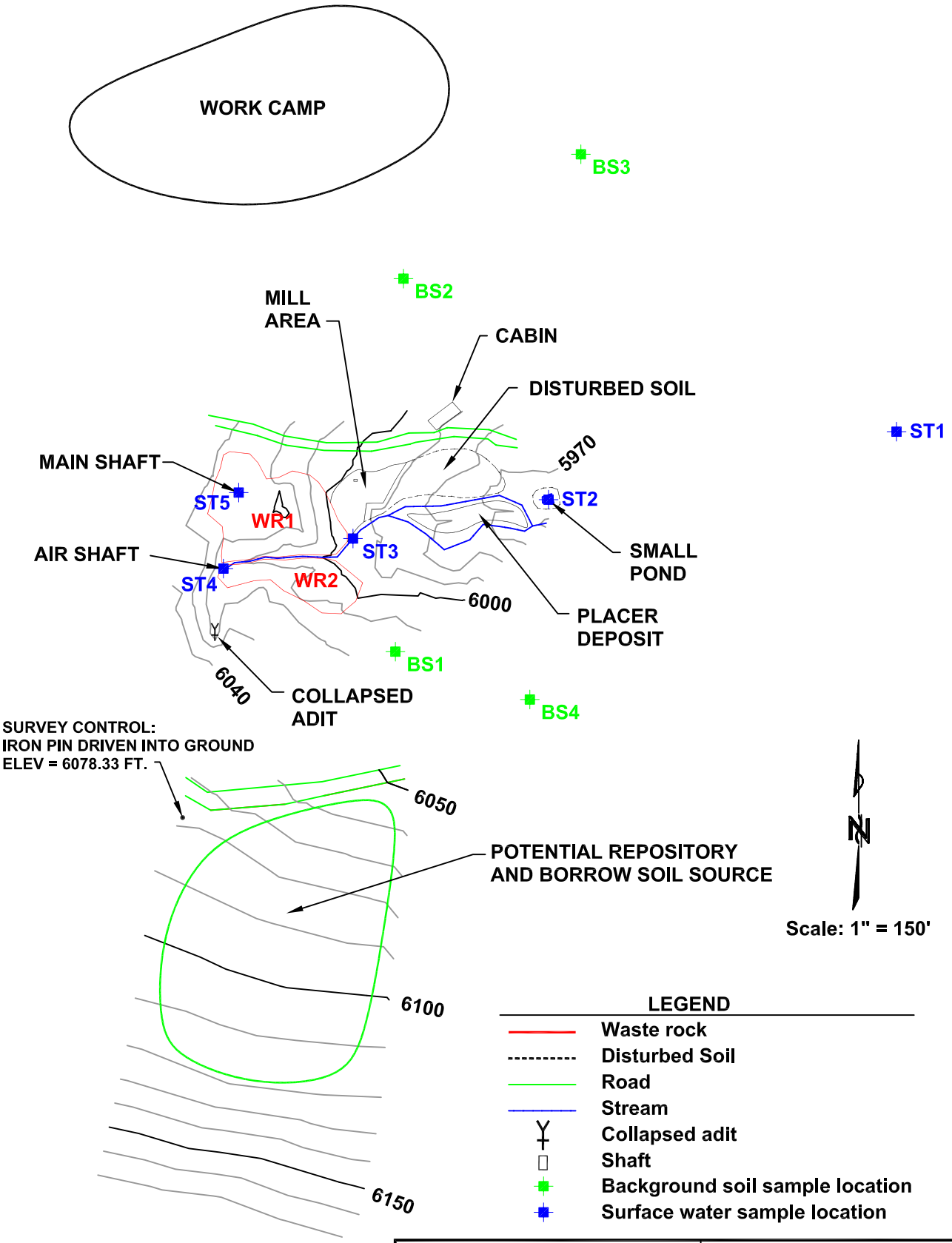


Base Map Source: Cornerstone Surveying, Inc. 6/23/08

MSE Millennium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
Phone: (208) 345-8292

Rabbit Mine Site Map

B2473G	figure2.dwg	2/6/09	Figure 2



MSE Millennium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
Phone: (208) 345-8292

Rabbit Mine Area Map

Base Map Source: Cornerstone Surveying, Inc. 6/23/08

B2473G	figure3.dwg	2/6/09	Figure 3

TABLES

TABLE 1
Monthly Climatic Averages for Granite, Oregon WSW
Rabbit Mine Site Inspection

Parameter	Month												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Average Maximum Temperature (°F)	30.3	36.4	40.1	49	58	66.2	77.58	76.2	68.9	55.8	40	32.2	52.6
Average Minimum Temperature (°F)	11.3	15.1	17	25.3	31.4	36.6	39.3	38.4	33.8	28.8	21.5	15.6	26.2
Average Total Precipitation (in)	3.66	2.93	2.73	1.87	2.33	1.76	0.6	0.71	1.08	1.93	2.93	3.84	26.37
Average Total Snowfall (in)	40.6	31.5	29.7	10.5	3.9	0.6	0.0	0.0	0.7	3.7	17.5	35.4	174.1
Average Snow Depth (in)	28	35	35	16	1	0	0	0	0	0	3	14	11

Notes:
Source: National Weather Service, Period of Record 7/02/48 to 10/16/67 (WRCC 2008)
Percent of possible observations for period of record: maximum temperature = 99.3%, minimum temperature = 99.2%, precipitation = 99.4%, snowfall = 99.1%, snow depth = 98.6%
°F = Degrees Fahrenheit
in = inches

TABLE 2
Summary of Mine Waste Volumes and Selected Metal Concentrations
Rabbit Mine Site Inspection

					Selected Maximum Detected Concentrations (mg/kg)		
Media	**Area**	**Description**	**Approximate Area (sf)**	**Estimated Volume (bcy)**	**Arsenic**	**Copper**	**Zinc**
Background soil	BS1 - BS4	Undisturbed areas	NA	NA	3.3	35.6	45.3
Waste Rock	WR1	At main shaft	11,700	2,470	1,280	118	270
	WR2	At air shaft and collapsed adit	5,200	570	44.3	71.9	48.1
	Mill area	Soil around mill foundation	2,900	320	69.1	73.6	66.2
Suspected Waste Rock	Below mill area	Disturbed soil below mill area	5,300	270	6.7	66.1	43.0
		Disturbed soil around pond	600	10	37.1	76.1	46.9
Placer/Waste Rock	Stream channel	Placer deposit in stream	2,400	170	29.9	92.4	50.5

Notes:
bcy = Bank cubic yard
mg/kg = Milligram per kilogram
NA = Not applicable
sf = Square foot

TABLE 3
Field Investigation Sample Summary
Rabbit Mine Site Inspection

Medium	Description	Number of Samples	Sample ID	Laboratory Analysis	Field Parameters
Mine Waste	Single grab sample from each suspected waste rock pile	15 Grab	WR1-RT-G-01 Through WR15-RT-G-01	All samples analyzed for pH, metals[(a)], total & WAD CN 20% (3 of 15 samples) also analyzed for As speciation 40% (6 of 15 samples) also analyzed for ABA, SPLP, and TCLP	Description
Background Soil	Single grab sample from four different locations representative of background conditions	4 Grab	BS1-RT-G-01 Through BS4-RT-G-01	All samples analyzed for pH and metals[(a)] 20% (1 of 4 samples) also analyzed for As speciation	Description
Solids QA/QC	Field duplicate of mine waste sample	1 MS/MSD	WR-RT-G-01-MSD	pH and metals[(a)]	None
Sediment	Composite samples of two subsamples from each stream surface water sample location	3 Composite	SD1-RT-C-01 Through SD3-RT-C-01	All samples analyzed for pH, metals[(a)], total & WAD CN, TOC 20% (1 of 3 samples) also analyzed for As speciation	Description
Background Water	Water from the main shaft and air shaft	2 Grab	SW4-RT-U-01 SW5-RT-U-02	All samples analyzed for total As, Cr, Hg, Se; sulfate, total & WAD CN, TDS, hardness, and pH 20% (1 of 2 samples) also analyzed for Cr and As speciation	pH, temp., DO, EC, ORP/Eh
			SW4-RT-F-01 SW5-RT-F-02	Dissolved metals[(a)]	
Surface Water	Water from intermittent stream	3 Grab	SW1-RT-U-01 SW2-RT-U-01 SW3-RT-U-01	All samples analyzed for total As, Cr, Hg, Se; sulfate, total & WAD CN, TDS, hardness, and pH 20% (1 of 3) also analyzed for Cr and As speciation	
			SW1-RT-F-01 SW2-RT-F-01 SW3-RT-F-01	Dissolved metals[(a)]	
Pore Water	Single grab sample from each stream surface water sample location	3 Grab	PW1-RT-U-01 PW2-RT-U-01 PW3-RT-U-01	All samples analyzed for total As, Cr, Hg, Se; sulfate, total & WAD CN, TDS, hardness, and pH 20% (1 of 3) also analyzed for Cr and As speciation	
			PW1-RT-F-01 PW2-RT-F-01 PW3-RT-F-01	Dissolved metals[(a)]	
Water QA/QC	Field duplicate of surface water sample	1 MS/MSD	SWX-RT-F-01-MSD	Dissolved metals[(a)], sulfate, hardness, and pH	None
	Equipment rinsate of field blank	1 Rinsate	RINSATE-F-01		
Benthic Organisms	Two composite samples from each of the two reaches on the intermittent stream, preferably co-located with two of the surface water sample locations	4 Grab	BM1-RT-C-01 BM2-RT-C-01 BM3-RT-C-01 BM4-RT-C-01	Taxonomy, generally to genus or species	pH, temp., DO, EC, ORP/Eh

Notes:

[a]Antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver and zinc.

ABA = Acid base accounting
CN = Cyanide
DO = Dissolved oxygen
EC = Electrical conductivity
Eh = Redox potential
MS/MSD = Matrix spike/matrix spike duplicate
ORP = Oxygen reduction potential
QA/QC = Quality assurance/quality control
SPLP = Synthetic Precipitate Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure
TDS = Total dissolved solids
Temp = Temperature
TOC = Total organic carbon
WAD = Weak acid dissociable

TABLE 4
Background Soil Analytical Results Summary
Rabbit Mine Site Inspection

Sample ID	Date Collected	Solids (%)	Paste pH	Analyte Concentration (mg/kg)														
				Ag	As_3	As_5	As_T	Cd	Cr_T	Cu	Fe	Hg	Ni	Pb	Sb	Se	Zn
BS1-RT-G-01	7/1/2008	80.2	6.46	*0.25*	*7.5*	*7.7*	2.0	0.86	43.6	32.8	30400	0.042	25.0	3.99	*1.0*	*2.0*	45.3
BS2-RT-G-01	7/1/2008	73.5	7.33	*0.25*	NA	NA	3.3	*0.10*	12.2	17.2	17500	0.040	16.0	5.12	2.3	*2.0*	30.8
BS3-RT-G-01	7/1/2008	79.0	6.92	*0.25*	NA	NA	2.9	*0.10*	42.5	35.6	36500	0.033	39.9	3.46	4.8	*2.0*	42.4
BS4-RT-G-01	7/1/2008	75.2	7.22	*0.25*	NA	NA	3.3	*0.10*	18.0	29.2	26700	0.038	20.2	4.60	3.3	*2.0*	41.0
minimum =		73.5	6.46	*0.25*	*7.5*	*7.7*	2.0	*0.10*	12.2	17.2	17500	0.033	16.0	3.46	*1.0*	*2.0*	30.8
MDC =		**80.2**	**7.33**	***0.25***	***7.5***	***7.7***	**3.3**	**0.86**	**43.6**	**35.6**	**36500**	**0.042**	**39.9**	**5.12**	**4.8**	***2.0***	**45.3**
average =		77.0	6.98	*0.25*	*7.5*	*7.7*	2.9	0.29	29.1	28.7	27775	0.038	25.3	4.29	2.9	*2.0*	39.9
90% UCL[a] =		NC	NC	*0.25*	7.5	7.7	3.4	0.86	42.4	35.3	34300	0.041	33.8	4.88	4.2	*2.0*	45.0
# of samples = 4; Standard Deviation =		NC	NC	0.00	0.0	0.0	0.6	0.33	14.1	7.0	6887	0.003	9.0	0.63	1.4	0.0	5.5
Frequency detected =		NC	NC	0%	0%	0%	100%	25%	100%	100%	100%	100%	100%	100%	75%	0%	100%
Human Health Screening Criteria																		
Oregon Industrial Maximum Allowable Soil Concentration Cleanup Levels (ODEQ 2000b)				10000	NS	NS	3	1000	1500	80000	NS	600	40000	2000	NS	NS	NS
EPA Region IX Industrial Soil PRGs (EPA 2004b)				5100	NS	NS	1.6	450	450	41000	100000	310	20000	800	410	5100	100000
Ecological Screening Criteria																		
Oregon Level II Screening Level Values for Plants, Invertebrates, and Wildlife (ODEQ 2001)				2	10	NS	NS	4	NS	50	10	0.1	30	16	5	1	50
EPA Ecological Soil Screening Levels (Eco-SSLs) (EPA 2005)				NS	NS	NS	18	0.36	NS	NS	NS	NS	NS	11	0.27	NS	NS

Notes:
Italics - result below reporting limit (RL); value = 1/2 RL.
Screening criteria exceeded.
[a]The MDC was used when the 90% UCL could not be calculated.
mg/kg = Milligram per kilogram
EPA = U.S. Environmental Protection Agency
MDC = Maximum detected concentration
NA = Not analyzed for
NC = Not calculated
NS = No screening criteria
ODEQ = Oregon Department of Environmental Quality
PRG = Preliminary remediation goal
UCL = Upper confidence limit

TABLE 5
Mine Waste Analytical Results Summary
Rabbit Mine Site Inspection

Area	Sample ID	Date Collected	Solids (%)	Paste pH	Analyte Concentration (mg/kg)															Sulfur Forms				Acid Base Accounting			
					CN (WAD)	CN (TOT)	Ag	As_3	As_5	As_T	Cd	Cr_T	Cu	Fe	Hg	Ni	Pb	Sb	Se	Zn	Pyritic (%)	Sulfate (%)	Non-extractable (%)	Total (%)	AGP ($TCaCO_3$/kT)	ANP ($TCaCO_3$/kT)	NNP ($TCaCO_3$/kT)	ANP/AGP Ratio
Waste rock pile WR1	WR1-RT-G-01	6/20/2008	88.9	7.99	*0.250*	*0.25*	*0.25*	*7.50*	52.3	52.3	2.18	60.2	97.8	60500	0.343	59.4	21.7	8.5	*2.0*	45.9	*0.005*	*0.005*	*0.005*	*0.005*	*0.15*	35.8	35.7	239
	WR2-RT-G-01[a]	6/20/2008	83.0	8.22	*0.250*	*0.25*	*0.25*	NA	NA	86.1	*0.10*	48.9	118	43350	0.143	61.7	9.32	6.7	*2.0*	61.0	*0.005*	*0.005*	*0.005*	*0.005*	*0.15*	76.7	76.6	511
	WR3-RT-G-01	6/20/2008	85.6	8.09	*0.250*	*0.25*	*0.25*	NA	NA	325	2.24	74.6	90.5	50900	0.733	52.4	57.0	14.2	*2.0*	77.7	NA	NA	NA	NA	NA	NA	NA	NA
	WR4-RT-G-01	6/20/2008	82.6	8.13	*0.250*	*0.25*	*0.25*	NA	NA	299	1.59	67.6	102	49000	1.49	54.7	194	9.9	*2.0*	270	NA	NA	NA	NA	NA	NA	NA	NA
	WR5-RT-G-01	6/20/2008	87.4	8.19	*0.250*	*0.25*	0.71	NA	NA	1280	2.26	42.6	86.5	64300	0.710	45.0	10.5	11.0	*2.0*	45.1	NA	NA	NA	NA	NA	NA	NA	NA
	WR6-RT-G-01	6/20/2008	88.5	8.47	*0.250*	*0.25*	*0.25*	*7.50*	723	723	2.76	25.5	70.5	79800	0.840	40.5	31.7	12.2	*2.0*	61.2	*0.005*	*0.005*	*0.005*	*0.005*	*0.15*	47.2	47.1	315
Waste rock pile WR2	WR7-RT-G-01	6/20/2008	86.5	8.10	*0.250*	*0.25*	*0.25*	NA	NA	21.0	0.94	87.8	65.5	49700	0.108	73.5	19.4	6.4	*2.0*	48.1	NA	NA	NA	NA	NA	NA	NA	NA
	WR8-RT-G-01	6/20/2008	83.9	7.66	*0.250*	*0.25*	*0.25*	NA	NA	44.3	*0.10*	60.2	71.9	48900	0.073	63.8	5.93	6.4	*2.0*	38.4	*0.005*	*0.005*	*0.005*	*0.005*	*0.15*	17.4	17.3	116
Soil around mill foundation	WR9-RT-G-01	6/20/2008	89.1	7.36	*0.250*	*0.25*	*0.25*	NA	NA	30.3	*0.10*	47.8	72.4	86100	0.090	56.8	6.15	11.7	*2.0*	66.2	NA	NA	NA	NA	NA	NA	NA	NA
	WR10-RT-G-01	6/20/2008	89.9	7.70	*0.250*	*0.25*	*0.25*	*7.50*	69.1	69.1	0.46	56.9	73.6	72000	0.487	57.1	10.4	10.1	*2.0*	64.8	*0.005*	*0.005*	*0.005*	*0.005*	*0.15*	23.1	23.0	154
	WR11-RT-G-01	6/20/2008	91.4	7.13	*0.250*	*0.25*	*0.25*	NA	NA	22.7	*0.10*	60.9	66.2	51700	0.083	48.7	5.76	6.7	*2.0*	51.6	NA	NA	NA	NA	NA	NA	NA	NA
	WR12-RT-G-01	6/20/2008	85.1	7.45	*0.250*	*0.25*	*0.25*	NA	NA	6.7	*0.10*	111	66.1	57300	*0.017*	76.8	0.96	7.8	*2.0*	43.0	NA	NA	NA	NA	NA	NA	NA	NA
Placer deposit	WR13-RT-G-01	6/20/2008	89.2	7.28	*0.250*	*0.25*	*0.25*	NA	NA	29.9	*0.10*	81.6	82.6	52000	2.63	56.3	16.6	7.4	*2.0*	50.5	*0.005*	*0.005*	*0.005*	*0.005*	*0.15*	18	17.9	120
	WR14-RT-C-01	6/20/2008	87.9	7.07	*0.250*	*0.25*	*0.25*	NA	NA	26.5	*0.10*	64.3	92.4	55900	0.380	58.3	7.80	7.6	*2.0*	49.9	NA	NA	NA	NA	NA	NA	NA	NA
Soil around pond	WR15-RT-C-01	6/20/2008	82.8	7.33	*0.250*	*0.25*	*0.25*	NA	NA	37.1	*0.10*	141	76.1	57500	0.055	79.9	2.19	7.4	*2.0*	46.9	NA	NA	NA	NA	NA	NA	NA	NA
	minimum =		82.6	7.07	*0.250*	*0.25*	*0.25*	*7.50*	52.3	6.7	*0.10*	25.5	65.5	43350	*0.017*	40.5	0.96	6.4	*2.0*	38.4	NC	NC	NC	NC	NC	NC	NC	NC
	MDC =		**91.4**	**8.47**	***0.250***	***0.25***	**0.71**	***7.50***	**723**	**1280**	**2.76**	**141**	**118**	**86100**	**2.63**	**79.9**	**194**	**14.2**	***2.0***	**270**	NC	NC	NC	NC	NC	NC	NC	NC
	average =		86.8	7.74	0.250	0.25	0.28	7.50	281	204	0.88	68.7	82.1	58597	0.55	59.0	26.6	8.9	2.0	68.0	NC	NC	NC	NC	NC	NC	NC	NC
	90% UCL[b] =		NC	NC	*0.250*	*0.25*	0.71	*7.50*	698	396	26.1	77.1	91.6	61000	1.21	62.9	44.1	9.5	*2.0*	270	NC	NC	NC	NC	NC	NC	NC	NC
	# of samples = 18; Standard Deviation =		NC	NC	0.000	0.000	0.11	0.000	312	342	1.0	27.5	14.9	11776	0.7	10.7	46.8	2.4	0.0	54.9	NC	NC	NC	NC	NC	NC	NC	NC
	Frequency detected =		NC	NC	0%	0%	7%	0%	100%	100%	47%	100%	100%	100%	93%	100%	100%	100%	0%	100%	NC	NC	NC	NC	NC	NC	NC	NC
Human Health Screening Criteria																												
Oregon Industrial Maximum Allowable Soil Concentration Cleanup Levels (ODEQ 2000b)					NS	40000	10000	NS	NS	3	1000	1500	80000	NS	600	40000	2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
EPA Region IX Industrial Soil PRGs (EPA 2004b)					NS	1200	5100	NS	NS	1.6	450	450	41000	100000	310	20000	800	410	5100	100000	NS	NS	NS	NS	NS	NS	NS	NS
Ecological Screening Criteria																												
Oregon Level II Screening Level Values for Plants, Invertebrates, and Wildlife (Lowest value, ODEQ 2001)					NS	NS	2	10	NS	NS	4	NS	50	10	0.1	30	16	5	1	50	NS	NS	NS	NS	NS	NS	NS	NS
EPA Ecological Soil Screening Levels (Eco-SSLs) (EPA 2005)					NS	NS	NS	NS	NS	18	0.36	NS	NS	NS	NS	NS	11	0.27	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes:
Italics - result below reporting limit (RL); value = 1/2 RL.
Screening criteria exceeded.
[a]Average of sample WR2-RT-G-01 and duplicate sample WR2-RT-G-02.
[b]The MDC was used when the 90% UCL could not be calculated.
mg/kg = Milligram per kilogram
$TCaCO_3$/kT = Ton of calcium carbonate per kiloton of waste
AGP = Acid generating potential
ANP = Acid neutralizing potential
EPA = U.S. Environmental Protection Agency
MDC = Maximum detected concentration
NA = Not analyzed for
NC = Not calculated
NNP = Net neutralizing potential
NS = No screening criteria
ODEQ = Oregon Department of Environmental Quality
PRG = Preliminary remediation goal
TOT = Total
UCL = Upper confidence limit
WAD = Weak acid dissociable

TABLE 6
Toxicity Characterization Leaching Procedure and Synthetic Leaching Procedure Results Summary
Rabbit Mine Site Inspection

Sample ID	Date Collected	Leachate Concentration (mg/L)													
		Arsenic		Cadmium		Chromium		Lead		Mercury		Selenium		Silver	
		TCLP	SPLP	TCLP	SPLP	TCLP	SPLP	TCLP	SPLP	TCLP	SPLP	TCLP	SPLP	TCLP	SPLP
WR1-RT-G-01	6/20/2008	*0.025*	*0.01*	0.01	*0.001*	*0.025*	*0.003*	*0.025*	*0.004*	*0.0001*	*0.0001*	*0.025*	*0.02*	*0.025*	*0.0025*
WR2-RT-G-01	6/20/2008	*0.025*	0.03	*0.005*	*0.001*	*0.025*	*0.003*	*0.025*	*0.004*	*0.0001*	0.0005	*0.025*	*0.02*	*0.025*	*0.0025*
WR6-RT-G-01	6/20/2008	0.08	0.5	0.019	*0.001*	*0.025*	*0.003*	*0.025*	*0.004*	*0.0001*	*0.0001*	*0.025*	*0.02*	*0.025*	*0.0025*
WR8-RT-G-01	6/20/2008	*0.025*	*0.01*	*0.005*	*0.001*	*0.025*	0.039	*0.025*	*0.004*	*0.0001*	*0.0001*	*0.025*	*0.02*	*0.025*	*0.0025*
WR10-RT-G-01	6/20/2008	*0.025*	*0.01*	*0.005*	*0.001*	*0.025*	0.038	*0.025*	*0.004*	*0.0001*	*0.0001*	*0.025*	*0.02*	*0.025*	*0.0025*
WR13-RT-G-01	6/20/2008	*0.025*	0.02	*0.005*	*0.001*	*0.025*	0.036	*0.025*	*0.004*	*0.0001*	*0.0001*	*0.025*	*0.02*	*0.025*	*0.0025*
RCRA TCLP Disposal Limit =		**5**		**1**		**5**		**5**		**0.2**		**1**		**5**	

Notes:
Italics - result below reporting limit (RL); value = 1/2 RL.
mg/L = Milligram per liter
RCRA = Resource Conservation and Recovery Act
SPLP = Synthetic Precipitation Leaching Procedure
TCLP = Toxicity Characteristic Leaching Procedure

TABLE 7
Sediment Analytical Results Summary
Rabbit Mine Site Inspection

Sample ID	Date Collected	Solids (%)	Total Organic Matter (%)	Total Organic Carbon (%)	Analyte Concentration (mg/kg)															
					CN (WAD)	CN (TOT)	Ag	As_3	As_5	As_T	Cd	Cr_T	Cu	Fe	Hg	Ni	Pb	Sb	Se	Zn
SD1-RT-C	6/19/2008	68.5	5.4	3.1	*1.25*	*0.25*	*0.25*	*7.5*	*7.7*	17.2	*0.10*	29.4	42.0	35600	0.060	21.5	2.66	*1.0*	*2.0*	38.6
SD2-RT-C	6/19/2008	54.3	4.7	2.7	*1.25*	*0.25*	*0.25*	NA	NA	7.1	*0.10*	45.8	38.4	23300	0.088	32.7	3.66	*1.0*	*2.0*	30.6
SD3-RT-C	6/19/2008	77.8	2.0	1.2	*1.25*	*0.25*	*0.25*	NA	NA	52.1	0.22	57.5	60.5	42800	0.062	37.7	5.49	*1.0*	*2.0*	46.1
minimum (excluding BG) =		54.3	2.0	1.2	*1.25*	*0.25*	*0.25*	*7.5*	*7.7*	7.1	*0.10*	29.4	38.4	23300	0.060	21.5	2.66	*1.0*	*2.0*	30.6
MDC (excluding BG) =		**77.8**	**5.4**	**3.1**	***1.25***	***0.25***	***0.25***	***7.5***	***7.7***	**52.1**	**0.22**	**57.5**	**60.5**	**42800**	**0.088**	**37.7**	**5.49**	***1.0***	***2.0***	**46.1**
average (excluding BG) =		66.9	4.0	2.3	*1.25*	*0.25*	*0.25*	*7.5*	*7.7*	25.5	0.14	44.2	47.0	33900	0.070	30.6	3.94	*1.0*	*2.0*	38.4
90% UCL[a] =		NC	NC	NC	*1.25*	*0.25*	*0.25*	*7.5*	*7.7*	51.2	0.22	57.5	59.9	42800	0.087	37.7	5.49	*1.0*	*2.0*	46.1
# of samples = 3; Standard Deviation =		NC	NC	NC	0.00	0.00	0.00	0.0	0.0	19	0.06	11.5	9.7	8051	0.013	6.8	1.17	0.0	0.0	6.3
Frequency detected =		NC	NC	NC	0%	0%	0%	0%	0%	100%	33%	100%	100%	100%	100%	100%	100%	0%	0%	100%
Human Health Screening Criteria																				
Oregon Industrial Maximum Allowable Soil Concentration Cleanup Levels – Human Receptors (ODEQ 2000b)					40000	40000	10000	NS	NS	3	1000	1500	80000	NS	600	40000	2000	NS	NS	NS
EPA Region IX Industrial Soil PRGs (EPA 2004b)					1200	1200	5100	NS	NS	1.6	450	450	41000	100000	310	20000	800	410	5100	100000
Ecological Screening Criteria																				
Oregon Guidance for Ecological Risk Assessment Level II Screening Level Values (Freshwater or bioaccumulation, whichever is lower, ODEQ 2001)					NS	NS	4.5	4	NS	NS	0.003	37	10	NS	0.2	18	35	3	0.1	3
EPA Threshold Effects Level (NOAA 1999)					NS	NS	NS	NS	NS	5.9	0.596	37.3	35.7	NS	0.174	18	35	NS	NS	123
EPA Freshwater Probable Effects Level (NOAA 1999)					NS	NS	NS	NS	NS	17	3.53	90	197	NS	0.486	35.9	91.3	NS	NS	315

Notes:

Italics - result below reporting limit (RL); value = 1/2 RL.

Screening criteria exceeded.

[a]The MDC was used when the 90% UCL could not be calculated.

mg/kg = Milligram per kilogram

BG = Background

CN = Cyanide

EPA = U.S. Environmental Protection Agency

MDC = Maximum detected concentration

NA = Not analyzed for

NC = Not calculated

NOAA = National Oceanic and Atmospheric Administration

NS = No screening criteria

ODEQ = Oregon Department of Environmental Quality

PRG = Preliminary remediation goal

TOT = Total

UCL = Upper confidence limit

WAD = Weak acid dissociable

TABLE 8
Surface Water Analytical Results Summary
Rabbit Mine Site Inspection

Sample ID	Date Collected	pH	Hard	Analyte Concentration (mg/L)[a] TDS	Ca_T	Mg_T	Sulfate	CN (WAD)	CN (TOT)	Ag_D	As_3	As_5	As_D	Cd_D	Cr_D	Cu_D	Fe_D	Hg_D	Ni_D	Pb_D	Sb_D	Se_D	Zn_D
SW5-RT-G-01 (background)	6/20/2008	6.59	31.2	55	7.36	3.11	0.83	*0.0050*	*0.0050*	*0.000063*	NA	NA	*0.00150*	*0.00010*	*0.00125*	0.00123	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
SW4-RT-G-01 (background)	6/19/2008	7.44	65.2	78	19.0	4.31	1.00	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.00150*	*0.00150*	*0.00010*	*0.00125*	*0.00050*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
average of background samples =		7.02	48.2	67	13.2	3.71	0.92	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.00150*	*0.00150*	*0.00010*	*0.00125*	*0.00087*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
SW3-RT-G-01	6/19/2008	7.85	78.0	94	23.1	4.90	1.12	*0.0050*	*0.0050*	*0.000063*	*0.00150*	0.00385	0.00385	*0.00010*	*0.00125*	*0.00050*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
SW2-RT-G-01 (pond)	6/19/2008	6.90	54.7	78	15.6	3.85	0.86	*0.0050*	*0.0050*	*0.000063*	NA	NA	*0.00150*	*0.00010*	*0.00125*	*0.00050*	0.101	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
SW1-RT-G-01	6/19/2008	7.74	59.4	80	16.2	4.58	1.10	*0.0050*	*0.0050*	*0.000063*	NA	NA	*0.00150*	*0.00010*	*0.00125*	*0.00050*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
minimum (excluding BG) =		6.90	54.7	78	15.6	3.85	0.86	*0.0050*	*0.0050*	*0.000063*	*0.00150*	0.00385	*0.00150*	*0.00010*	*0.00125*	*0.00050*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
MDC (excluding BG) =		**7.85**	**78.0**	**94**	**23.1**	**4.90**	**1.12**	***0.0050***	***0.0050***	***0.000063***	***0.00150***	**0.00385**	**0.00385**	***0.00010***	***0.00125***	***0.00050***	**0.101**	***0.00010***	***0.00050***	***0.00150***	***0.00150***	***0.00150***	***0.0050***
average (excluding BG) =		7.50	64.0	84	18.3	4.44	1.03	*0.0050*	*0.0050*	*0.000063*	*0.00150*	0.00385	0.00228	*0.00010*	*0.00125*	*0.00050*	0.054	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
90% UCL[b] =		NC	NC	95	24.8	5.03	1.18	*0.0050*	*0.0050*	*0.000063*	*0.00150*	0.00385	0.00385	*0.00010*	*0.00125*	*0.00050*	0.101	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
# of samples = 3; Standard Deviation =		NC	NC	7	3.4	0.44	0.12	0.0000	0.0000	0.000000	0.00000	0.00000	0.00111	0.00000	0.00000	0.00000	0.033	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000
Frequency detected =		NC	NC	100%	100%	100%	100%	0%	0%	0%	0%	100%	33%	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%
Human Health Screening Criteria																							
1 - Oregon HH		NS	NS	NS	NS	NS	NS	NS	0.14	0.050	NS	NS	0.0000022	NS	NS	NS	0.3	0.0001	0.61	NS	0.006	0.17	7.4
2 - EPA HH		5-9	NS	NS	NS	NS	NS	NS	0.14	NS	NS	NS	0.000018	NS	NS	1.3	0.3	NS	0.61	NS	0.006	0.17	7.4
Ecological Screening Criteria																							
3 - Oregon Eco[c]		NS	NS	NS	NS	NS	NS	NS	0.0052	0.0001	190	NS	NS	0.0002	NS	0.01	1	0.000012	0.028	1.26	NS	0.005	0.065
4 - EPA Eco[c]		NS	NS	NS	NS	NS	NS	NS	0.0052	0.00036	NS	0.0031	0.15	0.0002	NS	0.01	1	0.00077	0.028	1.26	0.03	0.005	0.065

Sample ID	Field Parameters Flow (gpm)	Temp. °C	EC (µS/cm)	DO (mg/L)	ORP (mV)
SW5-RT-G-01 (background)	Static	9.6	53.0	7.1	108.0
SW4-RT-G-01 (background)	6.2	4.5	88.7	8.4	86.4
SW3-RT-G-01	4.7	5.5	105.7	9.8	85.5
SW2-RT-G-01 (pond)	Static	18.0	106.3	3.8	332.6
SW1-RT-G-01	27	7.5	87.7	9.4	121.7

Notes:
Italics - result below reporting limit (RL); value = 1/2 RL.
Screening criteria exceeded.
[a]D denotes dissolved concentration; T denotes total concentration
[b]The MDC was used when the 90% UCL could not be calculated.
[c]Screening criteria for hardness dependent metals are based on the average hardness of the background samples, 48.2 mg/L.
1-State of Oregon human health water quality criteria, water and fish consumption, Tables 20, 33A, 33B (ODEQ 2005).
2-EPA recommended chronic ambient water quality criteria for human consumption of water and fish (EPA 2006).
3-State of Oregon ambient water quality criteria for protection of aquatic life, chronic criterion Tables 20, 33A, 33B (ODEQ 2005).
4-EPA recommended chronic ambient water quality criteria for freshwater aquatic life (EPA 2006); if none existed then used Tier II secondary chronic values (NOAA 1999).
°C = Celsius
gpm = Gallon per minute
mg/L = Milligram per liter
µS/cm = Microsiemen per centimeter
mV = Millivolt
BG = Background
CN = Cyanide
DO = Dissolved oxygen
EC = Electrical conductivity
EPA = U.S. Environmental Protection Agency
Hard = Hardness as calcium carbonate ($CaCO_3$)
MDC = Maximum detected concentration
NA = Not analyzed for
NC = Not calculated
NOAA = National Oceanic and Atmospheric Administration
NS = No screening criteria
ODEQ = Oregon Department of Environmental Quality
ORP = Oxygen reduction potential
TDS = Total dissolved solids
Temp = Temperature
TOT = Total
UCL = Upper confidence limit
WAD = Weak acid dissociable

TABLE 9
Pore Water Analytical Results Summary
Rabbit Mine Site Inspection

Sample ID	Date Collected	pH	Temp. (^{o}C)	Hard	Analyte Concentration (mg/L)[a]																	
					TDS	Ca_T	Mg_T	Sulfate	CN (WAD)	CN (TOT)	Ag_D	As_D	Cd_D	Cr_D	Cr_T	Cu_D	Fe_D	Hg_D	Ni_D	Pb_D	Sb_D	Se_D	Se_T	Zn
PW1-RT-G-01	6/19/2008	7.76	24.0	74.3	87	18.7	6.74	1.07	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.000100*	*0.00125*	0.0123	*0.00050*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
PW2-RT-G-01	6/19/2008	6.87	23.8	84.1	80	19.5	8.62	0.73	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.000100*	*0.00125*	0.0375	*0.00050*	0.158	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
PW3-RT-G-01	6/19/2008	7.80	24.4	85.8	96	24.4	6.04	1.11	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.000100*	*0.00125*	0.00394	*0.00050*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
minimum =		6.87	23.8	74.3	80	18.7	6.04	0.73	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.000100*	*0.00125*	0.0039	*0.00050*	*0.030*	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
MDC =		**7.80**	**24.4**	**85.8**	**96**	**24.4**	**8.62**	**1.11**	***0.0050***	***0.0050***	***0.000063***	***0.00150***	***0.000100***	***0.00125***	**0.0375**	***0.00050***	**0.158**	***0.00010***	***0.00050***	***0.00150***	***0.00150***	***0.00150***	***0.00150***	***0.0050***
average =		7.48	24.1	81.4	88	20.9	7.13	0.97	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.000100*	*0.00125*	0.0179	*0.00050*	0.073	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
90% UCL[b] =		NC	NC	NC	NC	24.2	8.59	1.11	*0.0050*	*0.0050*	*0.000063*	*0.00150*	*0.000100*	*0.00125*	0.0370	*0.00050*	0.158	*0.00010*	*0.00050*	*0.00150*	*0.00150*	*0.00150*	*0.00150*	*0.0050*
# of samples = 3; Standard Deviation =		NC	NC	NC	NC	2.5	1.09	0.17	0.0000	0.0000	0.000000	0.00000	0.000000	0.00000	0.0143	0.00000	0.060	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000
Frequency detected =		NC	NC	NC	NC	100%	100%	100%	0%	0%	0%	0%	0%	0%	100%	0%	33%	0%	0%	0%	0%	0%	0%	0%
Ecological Screening Criteria																								
1- Oregon Eco[a]		NS	NS	NS	NS	NS	NS	NS	NS	0.0052	0.0001	NS	0.0002	NS	NS	0.005	1	0.000012	0.028	0.0013	NS	0.005	0.005	0.06
2- EPA Eco[a]		6.5-9	NS	NS	NS	NS	NS	NS	NS	0.0052	0.00036	0.15	0.0002	NS	NS	0.008	1	0.00077	0.044	0.0024	0.03	0.005	0.005	0.10

Notes:

Italics - result below reporting limit (RL); value = 1/2 RL.

Screening criteria exceeded

[a]Screening criteria for hardness dependent metals are based on a average pore water hardness of 81.4; D denotes dissolved concentration; T denotes total concentration.

[b]The MDC was used when the 90% UCL could not be calculated.

1- State of Oregon ambient water quality criteria for protection of aquatic life, chronic criterion Tables 20, 33A, 33B (ODEQ 2005).

2- EPA recommended chronic ambient water quality criteria for freshwater aquatic life (EPA 2006); if none existed then used Tier II secondary chronic values (NOAA 1999).

^{o}C = Celsius
mg/L = Milligram per liter
CN = Cyanide
EPA = U.S. Environmental Protection Agency
Hard = Hardness as calcium carbonate ($CaCO_3$)
MDC = Maximum detected concentration
NOAA = National Oceanic and Atmospheric Administration
NC = Not calculated
NS = No screening criteria
TDS = Total dissolved solids
Temp = Temperature
TOT = Total
UCL = Upper confidence limit
WAD = Weak acid dissociable

TABLE 10
Aquatic Habitat Assessment Summary
Rabbit Mine Site Inspection

Habitat Parameter	Upstream Reach BM1-RT		Downstream Reach BM2-RT	
	Condition	Score	Condition	Score
Epifaunal Substrate/Available Cover	Optimal	17	Suboptimal	14
Embeddedness	Optimal	16	Optimal	18
Velocity/Depth Regime	Suboptimal	14	Optimal	17
Sediment Deposition	Suboptimal	15	Optimal	17
Channel Flow Status	Suboptimal	14	Optimal	16
Channel Alteration	Optimal	16	Suboptimal	11
Frequency of Riffles (or bends)	Suboptimal	13	Optimal	18
Bank Stability	Suboptimal	12	Suboptimal	13
Vegetative Protection	Suboptimal	14	Optimal	17
Riparian Vegetation Zone Width	Suboptimal	14	Optimal	18
Total Score =	**Suboptimal**	**145**	**Suboptimal**	**159**

TABLE 11
Benthic Macroinvertebrate Taxa Abundance Summary
Rabbit Mine Site Inspection

Taxon	Common name	Phylogeny	Stations			
			BM1-1[a]	BM1-2[a]	BM2-1[a]	BM2-2[a]
Turbellaria	flatworms	Phylum Turbellaria	47	17	2	6
Oligochaeta	segmented worms	Phylum Annelida			1	6
Pristinicola hemphilli	pristine pyrg hydrobiid snail	Phylum Mollusca			10	49
Ameletus	ameletid mayfly	Ephemeroptera: Ameletidae				1
Baetis bicaudatus	baetid mayfly	Ephemeroptera: Baetidae	3	1		
Diphetor hageni	baetid mayfly	Ephemeroptera: Baetidae				3
Drunella coloradensis	ephemerellid mayfly	Ephemeroptera: Ephemerellidae			1	
Cinygmula	heptageniid mayfly	Ephemeroptera: Heptageniidae			3	2
Zapada Oregonensis Group	nemourid stonefly	Plecoptera: Nemouridae	2			
Isoperla	perlodid stonefly	Plecoptera: Perlodidae	1			1
Allomyia	apataniid caddisfly	Trichoptera: Apataniidae	2	4		
Lepidostoma hoodi	lepidostomatid caddisfly	Trichoptera: Lepidostomatidae	1			
Limnephilidae	limnephilid caddisfly	Trichoptera: Limnephilidae		4		
Chyranda centralis	limnephilid caddisfly	Trichoptera: Limnephilidae				4
Rhyacophila Betteni Group	rhyacophilid caddisfly	Trichoptera: Rhyacophildae		2		
Chironomidae	chironomid midge	Diptera: Chironomidae	1		1	
Prosimulium	blackfly	Diptera: Simuliidae				1
		Total per 3.25 square feet	**57**	**28**	**18**	**73**

Notes:

[a]Full sample name includes RT - C (i.e. BM1-RT-C-1)

Used D-frame net, sampled about 3.25 square feet at each site, 500 micron mesh.

Samples were field sorted, about 1 hour sorting per sample, little organic material present.

Taxa identified by Aquatic Biology Associates, Inc., Corvallis, Oregon.

Abundances are per sample (3.25 square feet area).

TABLE 12
Human Health Hazard and Cancer Risk Summary
Rabbit Mine Site Inspection

Receptor	Media			TOTAL	Risk Screening Level[a]
	Mine Waste	Sediment	Surface Water		
	RME Hazard Quotient				
Child Recreationalist	0.3	0.04	0.0001	0.4	1
Adult Recreationalist	0.1	0.01	0.0001	0.1	1
Adult Worker	0.6	0.03	0.001	0.6	1
	CTE Hazard Quotient				
Child Recreationalist	0.02	0.002	0.00003	0.03	1
Adult Recreationalist	0.01	0.001	0.00004	0.01	1
Adult Worker	0.04	0.002	0.0001	0.04	1
	RME Cancer Risk				
Child Recreationalist	**1E-05**	**1E-06**	5E-09	**1E-05**	1E-06
Adult Recreationalist	**9E-06**	7E-07	3E-08	**1E-05**	1E-06
Adult Worker	**8E-05**	**4E-06**	8E-08	**9E-05**	1E-06
	CTE Cancer Risk				
Child Recreationalist	8E-07	3E-08	1E-09	8E-07	1E-06
Adult Recreationalist	5E-07	2E-08	2E-09	5E-07	1E-06
Adult Worker	**1E-06**	3E-08	3E-09	**1E-06**	1E-06

Notes:

[a]Oregon acceptable risk levels (ODEQ 2000a)

Bold values exceed risk screening levels.

CTE = Central tendency exposure

RME = Reasonable maximum exposure

TABLE 13
Summary of Hot Spots and Areas Exceeding Risk-based Cleanup Levels
Rabbit Mine Site Inspection

Media	Area	Contaminant	Risk-based Hot Spot Concentration (mg/kg)	Risk-based Cleanup Level (mg/kg)	Maximum Detected Concentration (mg/kg)	Estimated Volume (bcy)
Soil/Waste Rock	Waste rock pile WR1	Arsenic	460	46	1,280 = Hot Spot	2,470
	Soil around the mill foundation				69.1	600
Total Estimated Volume of Waste Material Exceeding Arsenic Cleanup Level =						**3,070**

Notes:

bcy = Bank cubic yard

mg/kg = Milligram per kilogram

TABLE 14
Ecological Risk Summary
Rabbit Mine Site Inspection

	Mine Waste				Surface Water			Sediment		Pore Water
CPEC	**Plant**	**Invertebrate**	**Bird**	**Mammal**	**Bird**	**Mammal**	**Aquatic Life**	**Freshwater**	**Bio-accumulation**	**Aquatic Life**
Antimony	<5	NS	NS	<5	--	--	--	**--**	--	--
Arsenic V	NS	NS	NS	NS	NS	NS	<5	--	--	--
Arsenic Total	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cadmium	<5	<5	<5	<5	--	--	**--**	<5	**73**	--
Chromium Total	NS	NS	NS	NS	--	--	**--**	<5	<5	--
Copper	<5	<5	<5	<5	NS	<5	<5	<5	**6**	--
Iron	**8,610**	**431**	NS	NS	--	--	**--**	--	--	--
Mercury	**9**	**26**	<5	<5	--	--	**--**	<5	NS	--
Silver	<5	<5	NS	NS	--	--	**--**	--	--	--
Zinc	**5**	<5	<5	<5	--	--	**--**	<5	**15**	--

Notes:

Bold values exceed Oregon's risk screening ratio for non-protected species, i.e. Q > 5 (ODEQ 2001).

CPEC = Contaminant of potential ecological concern

NS = No screening level value

-- Not calculated because not a CPEC for this media.

APPENDIX A

SENSITIVE PLANT AND ANIMAL SPECIES

FEDERALLY LISTED THREATENED, ENDANGERED, PROPOSED, CANDIDATE SPECIES AND SPECIES OF CONCERN WHICH MAY OCCUR WITHIN GRANT COUNTY, OREGON

LISTED SPECIES[1/]

Mammals		
Canada lynx[2/]	*Felis lynx canadensis*	T
Birds		
Bald eagle[3/]	*Haliaeetus leucocephalus*	T
Fish		
Steelhead (Middle Columbia River)[4/]	*Oncorhynchus mykiss* ssp.	T*
Bull trout (Columbia River Basin)[5/]	*Salvelinus confluentus*	CH T

PROPOSED SPECIES

None

CANDIDATE SPECIES[6/]

Mammals	
Pacific fisher[7/]	*Martes pennanti pacifica*
Birds	
Yellow-billed cuckoo	*Coccyzus americanus*
Amphibians and Reptiles	
Columbia spotted frog	*Rana luteiventris*

SPECIES OF CONCERN

Mammals	
Pygmy rabbit	*Brachylagus idahoensis*
Pale western big-eared bat	*Corynorhinus townsendii pallescens*
California wolverine	*Gulo gulo luteus*
Silver-haired bat	*Lasionycteris noctivagans*
Small-footed myotis (bat)	*Myotis ciliolabrum*
Long-eared myotis (bat)	*Myotis evotis*
Fringed myotis (bat)	*Myotis thysanodes*
Long-legged myotis (bat)	*Myotis volans*
Yuma myotis (bat)	*Myotis yumanensis*
California bighorn	*Ovis canadensis californiana*
Preble's shrew	*Sorex preblei*
Birds	
Northern goshawk	*Accipiter gentilis*
Western burrowing owl	*Athene cunicularia hypugea*
Upland sandpiper	*Bartramia longicauda*
Ferruginous hawk	*Buteo regalis*
Black tern	*Chlidonias niger*
Olive-sided flycatcher	*Contopus cooperi*
Willow flycatcher	*Empidonax trailli adastus*
Yellow-breasted chat	*Icteria virens*
Lewis' woodpecker	*Melanerpes lewis*
Mountain quail	*Oreortyx pictus*

White-headed woodpecker	*Picoides albolarvatus*
Amphibians and Reptiles	
Northern sagebrush lizard	*Sceloporus graciosus graciosus*
Fishes	
Malheur mottled sculpin	*Cottus bairdi* ssp.
Pacific lamprey	*Lampetra tridentata*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
Interior redband trout	*Oncorhynchus mykiss gibbsi*
Invertebrates	
California floater (mussel)	*Anodonta californiensis*
Plants	
Wallowa ricegrass	*Achnatherum wallowaensis*
Upward-lobed moonwort	*Botrychium ascendens*
Crenulate grape-fern	*Botrychium crenulatum*
Mountain grape-fern	*Botrychium montanum*
Twin spike moonwort	*Botrychium paradoxum*
Stalked moonwort	*Botrychium pedunculosum*
Peck's mariposa-lily	*Calochortus longebarbatus* var. *peckii*
Dwarf evening-primrose	*Camissonia pygmaea*
Idaho sedge	*Carex idahoa*
Colonial luina	*Luina serpentina*
Disappearing monkeyflower	*Mimulus evanescens*
Little mousetail	*Myosurus minimus* ssp. *apus* (= var. *sessiliflorus*)
Tiny-flower phacelia	*Phacelia minutissima*
Oregon semaphore grass	*Pleuropogon oregonus*
Arrow-leaf thelypody	*Thelypodium eucosmum*
Howell's theylpody	*Thelypodium howellii* ssp. *howellii*

(E) - Listed Endangered *(T) - Listed Threatened* *(CH) - Critical Habitat has been designated for this species*
(PE) - Proposed Endangered *(PT) - Proposed Threatened* *(PCH) - Critical Habitat has been proposed for this species*

Species of Concern - Taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

* *Consultation with NOAA's National Marine Fisheries Service may be required.*

[1/] *U.S. Department of Interior, Fish and Wildlife Service, October 31, 2000, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12*
[2/] *Federal Register Vol. 65, No. 58, Mar 24, 2000, Final Rule - Canada lynx*
[3/] *Federal Register Vol. 60, No. 133, July 12, 1995, - Final Rule - Bald Eagle*
[4/] *Federal Register Vol. 64, No. 57, March 25, 1999, Final Rule - Middle Columbia and Upper Willamette River Steelhead*
[5/] *Federal Register Vol. 63, No. 111, June 10, 1998, Final Rule - Columbia River and Klamath River Bull Trout*
[6/] *Federal Register Vol. 69, No. 86, May 4, 2004, Notice of Review - Candidate or Proposed Animals and Plants*
[7/] *Federal Register Vol. 69, No. 68, April 8, 2004, 12-Month Finding for a Petition to List the West Coast Distinct Population Segment of the Fisher*

LIST OF SPECIES THAT COULD POTENTIALLY INHABIT THE RABBIT MINE SITE

ELCODE	COMMON NAME	SPECIES NAME	FAMILY	TAXONOMIC CLASS
AMAJF04010	Ameican badger	Taxidea taxus	Mustelidae	Mammalia
AMAFE01010	American beaver	Castor canadensis	Castoridae	Mammalia
AMAJF01010	American marten	Martes americana	Mustelidae	Mammalia
AMAEA01020	American pika	Ochotona princeps	Ochotonidae	Mammalia
AMAFB05060	Belding's ground squirrel	Spermophilus beldingi	Sciuridae	Mammalia
AMACC04010	Big brown bat	Eptesicus fuscus	Vespertilionidae	Mammalia
AMALE04010	Bighorn sheep	Ovis canadensis	Bovidae	Mammalia
AMAJB01010	Black bear	Ursus americanus	Ursidae	Mammalia
AMALC02010	Black-tailed deer	Odocoileus hemionus	Cervidae	Mammalia
AMAEB03050	Black-tailed jack rabbit	Lepus californicus	Leporidae	Mammalia
AMAJH03020	Bobcat	Lynx rufus	Felidae	Mammalia
AMAFF08090	Bushy-tailed woodrat	Neotoma cinerea	Cricetidae	Mammalia
AMACC01120	California myotis	Myotis californicus	Vespertilionidae	Mammalia
AMAJH03010	Canada lynx	Lynx canadensis	Felidae	Mammalia
AMAFF03090	Canyon mouse	Peromyscus crinitus	Cricetidae	Mammalia
AMABB02020	Coast mole	Scapanus orarius	Talpidae	Mammalia
AMAFB05070	Columbian ground squirrel	Spermophilus columbianus	Sciuridae	Mammalia
AMAFJ01010	Common porcupine	Erethizon dorsatum	Erethizontidae	Mammalia
AMAJE02010	Common raccoon	Procyon lotor	Procyonidae	Mammalia
AMAJA01010	Coyote	Canis latrans	Canidae	Mammalia
AMAFF03040	Deer mouse	Peromyscus maniculatus	Cricetidae	Mammalia
AMAFB08020	Douglas' squirrel	Tamiasciurus douglasii	Sciuridae	Mammalia
AMABA01080	Dusky shrew	Sorex monticolus	Soricidae	Mammalia
AMALC01010	Elk	Cervus canadensis	Cervidae	Mammalia
AMAJF02010	Ermine	Mustela erminea	Mustelidae	Mammalia
AMAJF01020	Fisher	Martes pennanti	Mustelidae	Mammalia
AMACC01090	Fringed myotis	Myotis thysanodes	Vespertilionidae	Mammalia
AMAFB05170	Golden-mantled ground squirrel	Spermophilus lateralis	Sciuridae	Mammalia
AMAFD01070	Great Basin pocket mouse	Perognathus parvus	Heteromyidae	Mammalia
AMAFF10010	Heather vole	Phenacomys intermedius	Cricetidae	Mammalia
AMACC05030	Hoary bat	Lasiurus cinereus	Vespertilionidae	Mammalia
AMAFF22010	House mouse	Mus musculus	Muridae	Mammalia
AMAFB02020	Least chipmunk	Neotamias minimus	Sciuridae	Mammalia
AMACC01010	Little brown myotis	Myotis lucifugus	Vespertilionidae	Mammalia
AMACC01070	Long-eared myotis	Myotis evotis	Vespertilionidae	Mammalia
AMACC01110	Long-legged myotis	Myotis volans	Vespertilionidae	Mammalia
AMAFF11060	Long-tailed vole	Microtus longicaudus	Cricetidae	Mammalia
AMAJF02030	Long-tailed weasel	Mustela frenata	Mustelidae	Mammalia
AMAFB05210	Merriam's ground squirrel	Spermophilus canus	Sciuridae	Mammalia
AMAJF02050	Mink	Neovison vison	Mustelidae	Mammalia
AMAFF11020	Montane vole	Microtus montanus	Cricetidae	Mammalia
AMALE02010	Mountain goat	Oreamnos americanus	Bovidae	Mammalia
AMAJH04010	Mountain lion	Puma concolor	Felidae	Mammalia
AMAFF15010	Muskrat	Ondatra zibethicus	Cricetidae	Mammalia
AMAFB09020	Northern flying squirrel	Glaucomys sabrinus	Sciuridae	Mammalia
AMAFF06010	Northern grasshopper mouse	Onychomys leucogaster	Cricetidae	Mammalia

ELCODE	COMMON NAME	SPECIES NAME	FAMILY	TAXONOMIC CLASS
AMAFC01040	Northern pocket gopher	Thomomys talpoides	Geomyidae	Mammalia
AMAFF21020	Norway rat	Rattus norvegicus	Muridae	Mammalia
AMAEB01060	Nuttall's cottontail	Sylvilagus nuttallii	Leporidae	Mammalia
AMAFD03010	Ord's kangaroo rat	Dipodomys ordii	Heteromyidae	Mammalia
AMACC10010	Pallid bat	Antrozous pallidus	Vespertilionidae	Mammalia
AMAFF03130	Pinon mouse	Peromyscus truei	Cricetidae	Mammalia
AMALD01010	Pronghorn	Antilocapra americana	Antilocapridae	Mammalia
AMAEB04010	Pygmy rabbit	Brachylagus idahoensis	Leporidae	Mammalia
AMAJA03010	Red fox	Vulpes vulpes	Canidae	Mammalia
AMAFB08010	Red squirrel	Tamiasciurus hudsonicus	Sciuridae	Mammalia
AMAFF13010	Sagebrush vole	Lemmiscus curtatus	Cricetidae	Mammalia
AMACC02010	Silver-haired bat	Lasionycteris noctivagans	Vespertilionidae	Mammalia
AMAEB03010	Snowshoe hare	Lepus americanus	Leporidae	Mammalia
AMAFF09020	Southern red-backed vole	Myodes gapperi	Cricetidae	Mammalia
AMACC07010	Spotted bat	Euderma maculatum	Vespertilionidae	Mammalia
AMAJF06010	Striped skunk	Mephitis mephitis	Mephitidae	Mammalia
AMABA01070	Vagrant shrew	Sorex vagrans	Soricidae	Mammalia
AMABA01150	Water shrew	Sorex palustris	Soricidae	Mammalia
AMAFF11190	Water vole	Microtus richardsoni	Cricetidae	Mammalia
AMAFF02030	Western harvest mouse	Reithrodontomys megalotis	Cricetidae	Mammalia
AMAFH01020	Western jumping mouse	Zapus princeps	Dipodidae	Mammalia
AMACC03010	Western pipistrelle	Pipistrellus hesperus	Vespertilionidae	Mammalia
AMACC01140	Western small-footed myotis	Myotis ciliolabrum	Vespertilionidae	Mammalia
AMAJF05020	Western spotted skunk	Spilogale gracilis	Mephitidae	Mammalia
AMAEB03040	White-tailed jackrabbit	Lepus townsendii	Leporidae	Mammalia
AMAJF03010	Wolverine	Gulo gulo	Mustelidae	Mammalia
AMAFB03020	Yellow-bellied marmot	Marmota flaviventris	Sciuridae	Mammalia
AMAFB02030	Yellow-pine chipmunk	Neotamias amoenus	Sciuridae	Mammalia
AMACC01020	Yuma myotis	Myotis yumanensis	Vespertilionidae	Mammalia
ARADB36130	Common garter snake	Thamnophis sirtalis	Colubridae	Reptilia
ARADB26020	Gopher snake	Pituophis catenifer	Colubridae	Reptilia
ARADB18010	Night snake	Hypsiglena torquata	Colubridae	Reptilia
ARAAD01010	Painted turtle	Chrysemys picta	Emydidae	Reptilia
ARADB07010	Racer	Coluber constrictor	Colubridae	Reptilia
ARADB10010	Ringneck snake	Diadophis punctatus	Colubridae	Reptilia
ARADA01010	Rubber boa	Charina bottae	Boidae	Reptilia
ARACF14030	Sagebrush lizard	Sceloporus graciosus	Phrynosomatidae	Reptilia
ARACF12030	Short-horned lizard	Phrynosoma douglasii	Phrynosomatidae	Reptilia
ARACF17010	Side-blotched lizard	Uta stansburiana	Phrynosomatidae	Reptilia
ARACB01040	Southern alligator lizard	Elgaria multicarinata	Anguidae	Reptilia
ARADB21040	Striped whipsnake	Masticophis taeniatus	Colubridae	Reptilia
ARACF14080	Western fence lizard	Sceloporus occidentalis	Phrynosomatidae	Reptilia
ARADE02140	Western rattlesnake	Crotalus oreganus	Viperidae	Reptilia
ARACH01110	Western skink	Eumeces skiltonianus	Scincidae	Reptilia
ARADB36050	Western terrestrial garter snake	Thamnophis elegans	Colubridae	Reptilia
ARACJ02140	Western whiptail	Aspidoscelis tigris	Teiidae	Reptilia
AAABH01070	Bullfrog	Rana catesbeiana	Ranidae	Amphibia
AAABH01290	Columbia spotted frog	Rana luteiventris	Ranidae	Amphibia
AAABF02030	Great Basin spadefoot	Spea intermontana	Scaphiopodidae	Amphibia

ELCODE	COMMON NAME	SPECIES NAME	FAMILY	TAXONOMIC CLASS
AAAAA01080	Long-toed salamander	Ambystoma macrodactylum	Ambystomatidae	Amphibia
AAABC05100	Pacific chorus frog	Pseudacris regilla	Hylidae	Amphibia
AAABB01030	Western toad	Bufo boreas	Bufonidae	Amphibia
ABNGA01020	American bittern	Botaurus lentiginosus	Ardeidae	Aves
ABNME14020	American coot	Fulica americana	Rallidae	Aves
ABPAV10010	American crow	Corvus brachyrhynchos	Corvidae	Aves
ABPBH01010	American dipper	Cinclus mexicanus	Cinclidae	Aves
ABPBY06110	American goldfinch	Carduelis tristis	Fringillidae	Aves
ABNKD06020	American kestrel	Falco sparverius	Falconidae	Aves
ABPBX06010	American redstart	Setophaga ruticilla	Parulidae	Aves
ABPBJ20170	American robin	Turdus migratorius	Turdidae	Aves
ABNYF07110	American three-toed woodpecker	Picoides dorsalis	Picidae	Aves
ABNJB10180	American wigeon	Anas americana	Anatidae	Aves
ABPAE43050	Ash-throated flycatcher	Myiarchus cinerascens	Tyrannidae	Aves
ABNKC10010	Bald eagle	Haliaeetus leucocephalus	Accipitridae	Aves
ABPAU08010	Bank swallow	Riparia riparia	Hirundinidae	Aves
ABNSA01010	Barn owl	Tyto alba	Tytonidae	Aves
ABPAU09030	Barn swallow	Hirundo rustica	Hirundinidae	Aves
ABNSB12020	Barred owl	Strix varia	Strigidae	Aves
ABNXD01020	Belted kingfisher	Ceryle alcyon	Alcedinidae	Aves
ABNNM10020	Black tern	Chlidonias niger	Laridae	Aves
ABNYF07090	Black-backed woodpecker	Picoides arcticus	Picidae	Aves
ABPAV09010	Black-billed magpie	Pica hudsonia	Corvidae	Aves
ABPAW01010	Black-capped chickadee	Poecile atricapillus	Paridae	Aves
ABNUC45020	Black-chinned hummingbird	Archilochus alexandri	Trochilidae	Aves
ABNGA11010	Black-crowned night-heron	Nycticorax nycticorax	Ardeidae	Aves
ABPBX61040	Black-headed grosbeak	Pheucticus melanocephalus	Cardinalidae	Aves
ABPBX03070	Black-throated gray warbler	Dendroica nigrescens	Parulidae	Aves
ABNLC09020	Blue grouse	Dendragapus obscurus	Phasianidae	Aves
ABNJB10130	Blue-winged teal	Anas discors	Anatidae	Aves
ABPBXA9010	Bobolink	Dolichonyx oryzivorus	Icteridae	Aves
ABNSB15010	Boreal owl	Aegolius funereus	Strigidae	Aves
ABPBXB5020	Brewer's blackbird	Euphagus cyanocephalus	Icteridae	Aves
ABPBX94040	Brewer's sparrow	Spizella breweri	Emberizidae	Aves
ABPBA01010	Brown creeper	Certhia americana	Certhiidae	Aves
ABPBXB7030	Brown-headed cowbird	Molothrus ater	Icteridae	Aves
ABNSB10010	Burrowing owl	Athene cunicularia	Strigidae	Aves
ABPAY01010	Bushtit	Psaltriparus minimus	Aegithalidae	Aves
ABNLC23040	California quail	Callipepla californica	Odontophoridae	Aves
ABNUC48010	Calliope hummingbird	Stellula calliope	Trochilidae	Aves
ABNJB05030	Canada goose	Branta canadensis	Anatidae	Aves
ABNJB11020	Canvasback	Aythya valisineria	Anatidae	Aves
ABPBG04010	Canyon wren	Catherpes mexicanus	Troglodytidae	Aves
ABPBY04030	Cassin's finch	Carpodacus cassinii	Fringillidae	Aves
ABPBW01290	Cassin's vireo	Vireo cassinii	Vireonidae	Aves
ABPBN01020	Cedar waxwing	Bombycilla cedrorum	Bombycillidae	Aves
ABPAW01070	Chestnut-backed chickadee	Poecile rufescens	Paridae	Aves
ABPBX94020	Chipping sparrow	Spizella passerina	Emberizidae	Aves

ELCODE	COMMON NAME	SPECIES NAME	FAMILY	TAXONOMIC CLASS
ABNLC03010	Chukar	Alectoris chukar	Phasianidae	Aves
ABNJB10140	Cinnamon teal	Anas cyanoptera	Anatidae	Aves
ABPAV08010	Clark's nutcracker	Nucifraga columbiana	Corvidae	Aves
ABPAU09010	Cliff swallow	Petrochelidon pyrrhonota	Hirundinidae	Aves
ABNJB21010	Common merganser	Mergus merganser	Anatidae	Aves
ABNTA02020	Common nighthawk	Chordeiles minor	Caprimulgidae	Aves
ABNTA04010	Common poorwill	Phalaenoptilus nuttallii	Caprimulgidae	Aves
ABPAV10110	Common raven	Corvus corax	Corvidae	Aves
ABPBX12010	Common yellowthroat	Geothlypis trichas	Parulidae	Aves
ABNKC12040	Cooper's hawk	Accipiter cooperii	Accipitridae	Aves
ABPBXA5020	Dark-eyed junco	Junco hyemalis	Emberizidae	Aves
ABNYF07030	Downy woodpecker	Picoides pubescens	Picidae	Aves
ABPAE33090	Dusky flycatcher	Empidonax oberholseri	Tyrannidae	Aves
ABPAE52060	Eastern kingbird	Tyrannus tyrannus	Tyrannidae	Aves
ABPBT01010	European starling	Sturnus vulgaris	Sturnidae	Aves
ABPBY09020	Evening grosbeak	Coccothraustes vespertinus	Fringillidae	Aves
ABNKC19120	Ferruginous hawk	Buteo regalis	Accipitridae	Aves
ABNSB01020	Flammulated owl	Otus flammeolus	Strigidae	Aves
ABPBXA2010	Fox sparrow	Passerella iliaca	Emberizidae	Aves
ABNJB10160	Gadwall	Anas strepera	Anatidae	Aves
ABNKC22010	Golden eagle	Aquila chrysaetos	Accipitridae	Aves
ABPBJ05010	Golden-crowned kinglet	Regulus satrapa	Regulidae	Aves
ABPBXA0020	Grasshopper sparrow	Ammodramus savannarum	Emberizidae	Aves
ABPBK01010	Gray catbird	Dumetella carolinensis	Mimidae	Aves
ABPAE33100	Gray flycatcher	Empidonax wrightii	Tyrannidae	Aves
ABPAV01010	Gray jay	Perisoreus canadensis	Corvidae	Aves
ABNLC01010	Gray partridge	Perdix perdix	Phasianidae	Aves
ABNGA04010	Great blue heron	Ardea herodias	Ardeidae	Aves
ABNSB12040	Great gray owl	Strix nebulosa	Strigidae	Aves
ABNSB05010	Great horned owl	Bubo virginianus	Strigidae	Aves
ABNLC12010	Greater sage-grouse	Centrocercus urophasianus	Phasianidae	Aves
ABPBX74010	Green-tailed towhee	Pipilo chlorurus	Emberizidae	Aves
ABNYF07040	Hairy woodpecker	Picoides villosus	Picidae	Aves
ABPAE33080	Hammond's flycatcher	Empidonax hammondii	Tyrannidae	Aves
ABPBJ18110	Hermit thrush	Catharus guttatus	Turdidae	Aves
ABNJB20010	Hooded merganser	Lophodytes cucullatus	Anatidae	Aves
ABPAT02010	Horned lark	Eremophila alpestris	Alaudidae	Aves
ABPBY04040	House finch	Carpodacus mexicanus	Fringillidae	Aves
ABPBZ01010	House sparrow	Passer domesticus	Passeridae	Aves
ABPBG09010	House wren	Troglodytes aedon	Troglodytidae	Aves
ABNNB03090	Killdeer	Charadrius vociferus	Charadriidae	Aves
ABPBX96010	Lark sparrow	Chondestes grammacus	Emberizidae	Aves
ABPBX64020	Lazuli bunting	Passerina amoena	Cardinalidae	Aves
ABPAE33070	Least flycatcher	Empidonax minimus	Tyrannidae	Aves
ABPBY06090	Lesser goldfinch	Carduelis psaltria	Fringillidae	Aves
ABNJB11070	Lesser scaup	Aythya affinis	Anatidae	Aves
ABNYF04010	Lewis's woodpecker	Melanerpes lewis	Picidae	Aves
ABPBXA3020	Lincoln's sparrow	Melospiza lincolnii	Emberizidae	Aves

ELCODE	COMMON NAME	SPECIES NAME	FAMILY	TAXONOMIC CLASS
ABPBR01030	Loggerhead shrike	Lanius ludovicianus	Laniidae	Aves
ABNNF07070	Long-billed curlew	Numenius americanus	Scolopacidae	Aves
ABNSB13010	Long-eared owl	Asio otus	Strigidae	Aves
ABPBX11040	Macgillivray's warbler	Oporornis tolmiei	Parulidae	Aves
ABNJB10060	Mallard	Anas platyrhynchos	Anatidae	Aves
ABPBG10020	Marsh wren	Cistothorus palustris	Troglodytidae	Aves
ABPBJ15030	Mountain bluebird	Sialia currucoides	Turdidae	Aves
ABPAW01040	Mountain chickadee	Poecile gambeli	Paridae	Aves
ABNLC24010	Mountain quail	Oreortyx pictus	Odontophoridae	Aves
ABNPB04040	Mourning dove	Zenaida macroura	Columbidae	Aves
ABPBX01060	Nashville warbler	Vermivora ruficapilla	Parulidae	Aves
ABNYF10020	Northern flicker	Colaptes auratus	Picidae	Aves
ABNKC12060	Northern goshawk	Accipiter gentilis	Accipitridae	Aves
ABNKC11010	Northern harrier	Circus cyaneus	Accipitridae	Aves
ABNJB10110	Northern pintail	Anas acuta	Anatidae	Aves
ABNSB08010	Northern pygmy-owl	Glaucidium gnoma	Strigidae	Aves
ABPAU07010	Northern rough-winged swallow	Stelgidopteryx serripennis	Hirundinidae	Aves
ABNSB15020	Northern saw-whet owl	Aegolius acadicus	Strigidae	Aves
ABNJB10150	Northern shoveler	Anas clypeata	Anatidae	Aves
ABPAE32010	Olive-sided flycatcher	Contopus cooperi	Tyrannidae	Aves
ABPBX01050	Orange-crowned warbler	Vermivora celata	Parulidae	Aves
ABNKC01010	Osprey	Pandion haliaetus	Accipitridae	Aves
ABNKD06070	Peregrine falcon	Falco peregrinus	Falconidae	Aves
ABNCA02010	Pied-billed grebe	Podilymbus podiceps	Podicipedidae	Aves
ABNYF12020	Pileated woodpecker	Dryocopus pileatus	Picidae	Aves
ABPBY03010	Pine grosbeak	Pinicola enucleator	Fringillidae	Aves
ABPBY06030	Pine siskin	Carduelis pinus	Fringillidae	Aves
ABNKD06090	Prairie falcon	Falco mexicanus	Falconidae	Aves
ABPAZ01030	Pygmy nuthatch	Sitta pygmaea	Sittidae	Aves
ABPBY05010	Red crossbill	Loxia curvirostra	Fringillidae	Aves
ABPAZ01010	Red-breasted nuthatch	Sitta canadensis	Sittidae	Aves
ABPBW01240	Red-eyed vireo	Vireo olivaceus	Vireonidae	Aves
ABNJB11030	Redhead	Aythya americana	Anatidae	Aves
ABNYF05040	Red-naped sapsucker	Sphyrapicus nuchalis	Picidae	Aves
ABNKC19110	Red-tailed hawk	Buteo jamaicensis	Accipitridae	Aves
ABPBXB0010	Red-winged blackbird	Agelaius phoeniceus	Icteridae	Aves
ABNJB11040	Ring-necked duck	Aythya collaris	Anatidae	Aves
ABNLC07010	Ring-necked pheasant	Phasianus colchicus	Phasianidae	Aves
ABNPB01010	Rock pigeon	Columba livia	Columbidae	Aves
ABPBG03010	Rock wren	Salpinctes obsoletus	Troglodytidae	Aves
ABPBJ05020	Ruby-crowned kinglet	Regulus calendula	Regulidae	Aves
ABNJB22010	Ruddy duck	Oxyura jamaicensis	Anatidae	Aves
ABNLC11010	Ruffed grouse	Bonasa umbellus	Phasianidae	Aves
ABNUC51020	Rufous hummingbird	Selasphorus rufus	Trochilidae	Aves
ABPBK04010	Sage thrasher	Oreoscoptes montanus	Mimidae	Aves
ABNMK01010	Sandhill crane	Grus canadensis	Gruidae	Aves
ABPBX99010	Savannah sparrow	Passerculus sandwichensis	Emberizidae	Aves
ABPAE35030	Say's phoebe	Sayornis saya	Tyrannidae	Aves
ABNKC12020	Sharp-shinned hawk	Accipiter striatus	Accipitridae	Aves

ELCODE	COMMON NAME	SPECIES NAME	FAMILY	TAXONOMIC CLASS
ABNSB13040	Short-eared owl	Asio flammeus	Strigidae	Aves
ABPBXA3010	Song sparrow	Melospiza melodia	Emberizidae	Aves
ABNME08020	Sora	Porzana carolina	Rallidae	Aves
ABNNF04020	Spotted sandpiper	Actitis macularius	Scolopacidae	Aves
ABPBX74080	Spotted towhee	Pipilo maculatus	Emberizidae	Aves
ABPAV02010	Steller's jay	Cyanocitta stelleri	Corvidae	Aves
ABNKC19070	Swainson's hawk	Buteo swainsoni	Accipitridae	Aves
ABPBJ18100	Swainson's thrush	Catharus ustulatus	Turdidae	Aves
ABPBJ16010	Townsend's solitaire	Myadestes townsendi	Turdidae	Aves
ABPBX03080	Townsend's warbler	Dendroica townsendi	Parulidae	Aves
ABPAU03010	Tree swallow	Tachycineta bicolor	Hirundinidae	Aves
ABNKA02010	Turkey vulture	Cathartes aura	Cathartidae	Aves
ABNNF06010	Upland sandpiper	Bartramia longicauda	Scolopacidae	Aves
ABPBJ22010	Varied thrush	Ixoreus naevius	Turdidae	Aves
ABNUA03020	Vaux's swift	Chaetura vauxi	Apodidae	Aves
ABPBJ18080	Veery	Catharus fuscescens	Turdidae	Aves
ABPBX95010	Vesper sparrow	Pooecetes gramineus	Emberizidae	Aves
ABPAU03040	Violet-green swallow	Tachycineta thalassina	Hirundinidae	Aves
ABNME05030	Virginia rail	Rallus limicola	Rallidae	Aves
ABPBW01210	Warbling vireo	Vireo gilvus	Vireonidae	Aves
ABPBJ15020	Western bluebird	Sialia mexicana	Turdidae	Aves
ABNCA04010	Western grebe	Aechmophorus occidentalis	Podicipedidae	Aves
ABPAE52050	Western kingbird	Tyrannus verticalis	Tyrannidae	Aves
ABPBXB2030	Western meadowlark	Sturnella neglecta	Icteridae	Aves
ABNSB01040	Western screech-owl	Megascops kennicottii	Strigidae	Aves
ABPBX45050	Western tanager	Piranga ludoviciana	Thraupidae	Aves
ABPAE32050	Western wood-pewee	Contopus sordidulus	Tyrannidae	Aves
ABPAZ01020	White-breasted nuthatch	Sitta carolinensis	Sittidae	Aves
ABPBXA4040	White-crowned sparrow	Zonotrichia leucophrys	Emberizidae	Aves
ABNYF07070	White-headed woodpecker	Picoides albolarvatus	Picidae	Aves
ABNUA06010	White-throated swift	Aeronautes saxatalis	Apodidae	Aves
ABNLC14010	Wild turkey	Meleagris gallopavo	Phasianidae	Aves
ABNYF05030	Williamson's sapsucker	Sphyrapicus thyroideus	Picidae	Aves
ABPAE33040	Willow flycatcher	Empidonax traillii	Tyrannidae	Aves
ABNNF20010	Wilson's phalarope	Phalaropus tricolor	Scolopacidae	Aves
ABNNF18030	Wilson's snipe	Gallinago delicata	Scolopacidae	Aves
ABPBX16020	Wilson's warbler	Wilsonia pusilla	Parulidae	Aves
ABPBG09050	Winter wren	Troglodytes troglodytes	Troglodytidae	Aves
ABNJB09010	Wood duck	Aix sponsa	Anatidae	Aves
ABPBX03010	Yellow warbler	Dendroica petechia	Parulidae	Aves
ABPBX24010	Yellow-breasted chat	Icteria virens	Parulidae	Aves
ABPBXB3010	Yellow-headed blackbird	Xanthocephalus xanthocephalus	Icteridae	Aves
ABPBX03060	Yellow-rumped warbler	Dendroica coronata	Parulidae	Aves

APPENDIX B

STREAMLINED HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

STREAMLINED HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Rabbit Mine
Wallowa-Whitman National Forest, Oregon — February 2009

Principal Author: Leslie Eldridge, P.E.

Reviewed By: Michael Puett, P.E.

Prepared For: USDA Forest Service
Gifford Pinchot National Forest
10600 NE 51st Circle
Vancouver, WA 98682

Prepared by: Millennium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
(208) 345-8292

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ACRONYMS AND ABBREVIATIONS

bcy	Bank cubic yard
cm^2	Square centimeter
cm/hr	Centimeter per hour
kg	Kilogram
L/cm^3	Liter per cubic centimeter
m^3/day	Cubic meter per day
m^3/kg	Cubic meter per kilogram
mg/cm^2/day	Milligram per square centimeter per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg-day	Milligram per kilogram per day
mg/L	Milligram per liter
ABA	Acid base accounting
ALM	Adult Lead Methodology
AWQC	Ambient water quality criteria
BLM	United States Bureau of Land Management
CDI	Chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
CNS	Central nervous system
COI	Contaminant of interest
COPC	Contaminant of potential concern
CPEC	Contaminant of potential ecological concern
CSEM	Conceptual site exposure model
CSM	Conceptual site model
CTE	Central tendency exposure
DOE	U.S. Department of Energy
ECR	Excess cancer risk
EF	Exposure factor
EPA	United States Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
FWS	U.S. Fish and Wildlife Service
HEAST	Health Effects Assessment Screening Tables
HHRA	Human health risk assessment
HI	Hazard Index
HQ	Hazard Quotient
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
LOAEL	Lowest observed adverse effects level

ACRONYMS AND ABBREVIATIONS (continued)

MCL	Maximum contaminant level
MSE	Millennium Science and Engineering, Inc.
NCEA	National Center for Environmental Risk Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFS	National Forest System
NOAEL	No observed adverse effects level
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
PRG	Preliminary Remediation Goal
RAGS	Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System
RfD	Reference dose
RL	Reporting limit
RMC	Risk Management Criteria
RME	Reasonable maximum exposure
SARA	Superfund Amendments and Reauthorization Act
SF	Slope factor
SI	Site Inspection
SLV	Screening level value
SOC	Species of concern
T&E	Threatened and endangered
TRV	Toxicity reference value
UCL_{90}	90 percent upper confidence limit

1.0 INTRODUCTION

- Streamlined human health and ecological risk assessments were completed for the Rabbit Mine Site using analytical data and other information gathered during the Site Inspection (SI) and field investigation by Millennium Science and Engineering, Inc. (MSE).
  - A streamlined risk assessment focuses on and evaluates only the principal exposure pathways and significant targets of concern. The objective is to simply determine whether sufficient risk is present to warrant a removal action.
  - The streamlined process is intended to eliminate unnecessary data development and analysis, and reduce the overall effort and cost of a removal action. This approach recognizes that the elimination of all uncertainties is not possible or necessary, and uses only the data needed to generally characterize potential risks and support the development and selection of removal action alternatives.
- The purpose of the streamlined risk assessments was to assess potential hazards and risks to human and ecological receptors from exposure to mine waste and contaminated media at the Site.
- Primary objectives of the risk assessments were to:
  - Determine 90 percent Upper Confidence Limit (UCL_{90}) concentrations;
  - Assess potential risks to human and ecological receptors at the Site;
  - Identify hot spots, i.e. highly contaminated areas that contribute a large percentage of the overall site risk; and
  - Establish appropriate risk-based, site-specific, cleanup levels.
- This document describes the risk assessment methodology, assumptions, and potential risks to human and ecological receptors at the Site.
  - A detailed description of the Site location, background, field investigation, and physiography is presented in the SI report and will not be reiterated here.
  - Summary tables are presented at the end of the report and human health and ecological risk calculation tables are presented in Attachments A and B, respectively.
  - A list of threatened and endangered (T&E) wildlife and plant species, as well as species of concern (SOC), is provided in the SI report.

2.0 DATA REVIEW

- Analytical results of samples collected during the field investigation were tabulated and reviewed to ensure suitability for use in the risk assessments.
- Data used in the risk assessments included results of background soil, mine waste, surface water, pore water, and sediment samples collected during the field investigation. The analytical results are presented in the SI report.
- The laboratory reporting limit (RL) for analytical results reported as not detected (i.e. below the RL) were compared to human health and ecological screening criteria to ensure the RLs were below the applicable criteria.
  - The RL is the lowest concentration is the lowest concentration at which an analyte can be detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision. If the RL is above screening criteria, a sample concentration may be reported as not detected but still be above the screening criteria.
  - In surface water, the RLs for arsenic and mercury were above one or more ecological screening criteria.
    - The arsenic RL (0.00150 milligrams per liter [mg/L]) for all surface water samples was above the U.S. Environmental Protection Agency's (EPA) Recommended Chronic Ambient Water Quality Criteria (AWQC) for Human Consumption of Water and Fish (0.000018 mg/L, EPA 2006), and Oregon's Human Health Water Quality Criteria, water

and fish consumption for arsenic (III) (0.0000022 mg/L, Oregon Department of Environmental Quality [ODEQ] 2005).
    - The mercury RL (0.00010 mg/L) for all surface water samples was above Oregon's Chronic AWQC for Protection of Aquatic Life (0.000012 mg/L, ODEQ 2005).
  - In pore water, the RL for mercury was above one ecological screening criterion.
    - The mercury RL (0.00010 mg/L) was above EPA's recommended AWQC for freshwater aquatic life (0.000012 mg/L, EPA 2006).
  - In waste rock and soil, the RL for selenium exceeded one ecological screening criterion.
    - The selenium RL (2.0 milligrams per kilogram [mg/kg]) was above Oregon's Level II Screening Level Value (SLV) for plants (ODEQ 2001).
  - For those analytes in surface water and pore water that are hardness dependent, the criteria were adjusted based on the average background hardness (ODEQ 2001).
- The maximum detected concentration (MDC), mean concentration, and UCL_{90} of the arithmetic mean concentration were determined for the contaminants of interest (COI) in all media.
  - In determining the average and UCL_{90} concentrations, samples with undetected concentrations were conservatively included at concentrations equal to ½ the RL in accordance with EPA guidelines (EPA 1991).

3.0 INITIAL RISK SCREENING

- The maximum detected COI concentrations were compared to U.S. Bureau of Land Management (BLM) Risk Management Criteria (RMC) to provide a preliminary qualitative assessment of potential risk to human and ecological receptors at the Site.
  - The RMCs were developed as a screening tool for quickly assessing overall risks to humans and wildlife at abandoned mining sites and are based on the most problematic metals (antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, silver, zinc) typically found at abandoned mine sites, on available toxicity data, and standard EPA exposure assumptions (Ford 2004).
  - Comparing the maximum detected COI concentrations to the RMCs provides an estimate of risk in logarithmic terms, with relative risk expressed in terms of the factor by which COI concentrations exceed the reference RMC.
  - This initial risk screening process is intended to provide only a general level of risk and is, therefore, independent of the streamlined quantitative risk assessments.
  - Results of the RMC screening are discussed below and summarized in Table 1.

3.1 Human Health Risk Screening

- Ford (2004) developed human health RMCs for soil, sediment, and surface water based on exposure scenarios that could potentially occur at abandoned mine sites, including camper, all-terrain vehicle driver, worker, surveyor, boater, swimmer, and resident.
  - The RMCs correspond to either a target Excess Cancer Risk (ECR) of 1.E-05, or a target non-carcinogenic Hazard Index (HI) of 1.
  - For metals posing both carcinogenic and non-carcinogenic threats to health, the lower (more protective) concentration is used for the RMC. For a target ECR of 1.E-05, an individual exposed at the RMC under the BLM exposure conditions would have a 1 in 100,000 chance to develop any type of cancer in a lifetime as a result of contact with the metal of concern.
  - An HI of <1 is assigned when the dose of non-carcinogenic metals assumed to be received at the Site by any of the receptors is lower than the dose that may result in adverse non-carcinogenic health effects.
  - The RMCs are protective for exposures to multiple chemicals and media.

- Because of the limited available toxicological information regarding health risks associated with exposure to lead, the lead RMC was determined from the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model and other EPA regulations and guidance (Ford 2004).
- The RMCs apply to soil, mine waste, sediment and surface water at the Site.

- The maximum detected COI concentrations in the mine waste, background soil, sediment, and surface water samples collected during the field investigation were compared to the RMCs for the camper receptor classification.
  - Arsenic was the only COI to exceed human health RMCs.
  - The initial risk screening results, shown in Table 1, indicate a high risk to human receptors from exposure to arsenic in mine waste and a moderate risk from exposure to sediment at the Site.
  - There does not appear to be a human health risk from exposure to surface water at the Site.

3.2 Ecological Risk Screening

- Ford developed ecological RMCs for soil from a survey of literature for toxicity data relevant to either wildlife receptors at BLM sites or to closely related species.
  - For receptors without available toxicity data, Ford selected data based on phylogenetic similarity between ecological receptors and the test species for which toxicity data were reported. He obtained soil ingestion data for each receptor from a study on dietary soil content of wildlife from the U.S. Fish and Wildlife Service (FWS).
  - For receptors without available dietary soil content data, he assumed soil content was equal to that of an animal with similar diets and habits.
  - The amount of soil ingested by each receptor was estimated as a proportion of their daily food intake. Ford then calculated the food intake in grams for each receptor as a function of body weight based on scaling factors specific to each type of species.
- Ford calculated RMCs for metals in soil based upon assumed exposure factors (EF) for the specific receptors and species- and chemical-specific toxicity reference values (TRV).
  - The TRVs represent daily doses of the metals for each wildlife receptor that will not result in any adverse toxic effects. Ford computed the TRVs for each wildlife receptor/metal combination for which toxicity data were available.
  - Phylogenetic and intraspecies differences between test species and ecological receptors were accounted for by applying uncertainty factors derived from critical toxicity values. These uncertainty factors were applied to protect wildlife receptors that might be more sensitive to the toxic effects of a metal than the test species.
  - In accordance with this system, Ford applied a divisor of two to the toxicity reference dose for each level of phylogenetic difference between the test and wildlife species (in essence, individual, species, genus, and family).
- The maximum detected COI concentrations in the mine waste and background soil were compared to ecological RMCs for four potential receptors: deer mouse, mule deer, elk, and robin.
  - The initial mine waste screening results, shown in Table 1, indicate moderate to extremely high risk to all receptors from exposure to arsenic, cadmium, and lead.
    - Copper poses a moderate risk to the mule deer and a high risk to the robin.
    - Mercury poses a moderate risk to the deer mouse and robin, and zinc poses a moderate risk to the mule deer and robin.
    - There is also moderate risk to the robin from exposure to arsenic, cadmium, copper, lead, and zinc in the background soil.

4.0 STREAMLINED HUMAN HEALTH RISK ASSESSMENT

- The streamlined human health risk assessment (HHRA) was prepared to assess potential hazards and risks to human receptors from exposure to mine waste and contaminated media at the Site.
- The HHRA used analytical data and other information gathered during the field investigation by MSE in June 2008 and site-specific EFs based on the anticipated receptors and future land uses.
- Both central tendency exposure (CTE) and reasonable maximum exposure (RME) scenarios were evaluated.
- The HHRA was prepared in general accordance with state and federal regulations and guidelines, including:
  - Comprehensive Environmental Response and Compensation Liability Act (CERCLA)
  - Superfund Amendments and Reauthorization Act (SARA)
  - National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40CFR 300.415(b)(4)(i)
  - EPA's *"Risk Assessment Guidance for Superfund Volume I – Human Health Evaluation Manual Part (A)"*, (EPA 1991)
  - EPA's *"Exposure Factors Handbook"* (EPA 1997a)
  - EPA's *"Risk Assessment Guide for Superfund, Part E, Supplemental Guidance for Dermal Risk Assessment"* (EPA 2004a)
  - ODEQ's *"Guidance for Conduct of Deterministic Human Health Risk Assessment"* (ODEQ 2000a)
- The streamlined HHRA process consisted of six steps:
  - **Step 1** – Exposure Assessment
  - **Step 2** – Toxicity Assessment
  - **Step 3** – Risk Characterization
  - **Step 4** – Uncertainty Analysis
  - **Step 5** – Hot Spot Assessment
  - **Step 6** – Development of Risk-based Cleanup Levels
- Each step is discussed in the following sections and summary tables are provided at the end of the report. Human health risk calculation tables are provided in Attachment A.

4.1 Exposure Assessment

- The exposure assessment involved:
  - Preparing a conceptual site model (CSM),
  - Identifying the potentially exposed populations at the Site ,
  - Determining the potentially complete exposure pathways,
  - Identifying the contaminants of potential concern (COPC),
  - Estimating exposure point concentrations (EPC), and
  - Developing a set of EFs and assumptions for use in the risk calculations.

4.1.1 Human Health Conceptual Site Model

- A human health CSM, shown in Figure 1, was prepared for the Site to provide a framework for assessing risk by identifying the following:
  - The environmental setting and contaminants known or suspected to exist at the Site,
  - Contaminant fate and transport mechanisms that might exist at the Site,
  - Mechanisms of toxicity associated with contaminants and potential receptors,
  - Complete exposure pathways that might exist at the Site, and

- Potential exposed populations.
- The Rabbit Mine CSM was based on information gathered during preparation of the SI and should be representative of current and likely future conditions at the Site.

4.1.2 Potentially Exposed Populations

- While the Site is in a relatively remote location, the historic mining community of Greenhorn is approximately 0.6 miles southwest of the Site. The population of Greenhorn was reported to be 2 in 2006; however, the area is frequented by seasonal inhabitants and visitors (Cockle 2008).
- Although there are no developed recreational areas near the Site, public exploration and recreational use of the Site is likely moderate because of the proximity to Greenhorn, ease of access, and large number of historic mines in the area.
- Recreational uses are likely to include hiking, camping, hunting, timber harvesting, firewood cutting, and minerals prospecting.
- Future uses of the Site are expected to remain the same as current uses. Residential development of the Site is believed to be unlikely; therefore, the risk of long-term exposure to contaminants at the Site is considered low.
- Three primary receptors that are anticipated to visit the Site were evaluated:
  - Worker – Adult Receptor
  - Recreationalist – Adult Receptor
  - Recreationalist – Child Receptor

4.1.3 Potentially Complete Exposure Routes

- Based on the anticipated receptors, the following exposure pathways were evaluated:
  - Incidental ingestion of mine waste (waste rock) and sediment;
  - Ingestion of surface water as a drinking source;
  - Dermal contact with mine waste, surface water, and sediment; and
  - Inhalation of mine waste particulates.
- Other potentially complete pathways, such as groundwater ingestion, plant ingestion, and fish tissue ingestion were qualitatively considered but not quantified.
  - The groundwater pathway at the Site is considered incomplete because there are no groundwater uses at the Site and there does not appear to be any nearby wells that are hydraulically connected to the Site.
  - Vegetation samples were not collected during the field investigation; however, no palatable species were documented on the Site. It's also unlikely that the Site will be used for agricultural cultivation; therefore, plant ingestion was determined to be a potentially complete but insignificant pathway.
  - The intermittent stream and small pond do not support a viable fish habitat; therefore, risks from the ingestion of fish were not quantified.

4.1.4 Contaminants of Potential Concern

- Analytical results of mine waste, sediment, and surface water samples collected during the field investigation were screened in accordance with EPA guidance (EPA 2001) to identify COPCs.
- The screening process consisted of three steps:
  - Determining the frequency of detection
  - Comparing sample concentrations to background concentrations
  - Comparing sample concentrations to established criteria for potential toxicity

- Essential nutrients (calcium, iron, magnesium, potassium, and sodium) were not present at concentrations that would pose a threat to human health; therefore, they were screened from further analysis.
- **Frequency of Detection Screening** – COIs detected in fewer than 5 percent of the samples site-wide for a given media were eliminated from further screening.
  - All COIs except selenium and cyanide were detected in more than 5 percent of the mine waste samples.
  - Silver, antimony, selenium and cyanide were not detected in any of the sediment samples.
  - Silver, cadmium, chromium, mercury, nickel, lead, antimony, selenium, zinc, and cyanide were not detected in any of the surface water samples.
- **Comparison with Background Concentration Screening** – COIs with maximum detected concentrations (MDC) below background concentrations were eliminated from further screening. Background UCL_{90} concentrations were used for mine waste and surface water; however, mean background concentrations could not be used for sediment because no background samples were collected.
  - In mine waste, all COIs except selenium and cyanide were above background and retained for further screening.
  - In surface water, arsenic (total), copper, and iron were the only COIs detected above background and retained for further screening.
- **Concentration-risk Screening –** The COI MDCs were compared to the lower of: (1) EPA Region IX Industrial Soil Preliminary Remediation Goals (PRG, EPA 2004b), and (2) Oregon Industrial Maximum Allowable Soil Concentration Cleanup Levels (ODEQ 2000b).
  - Industrial criteria were used for mine waste and sediment because there are no established criteria for a recreational use scenario and residential development of the Site is believed to be unlikely. However, it should be noted that the industrial criteria are very conservative for this Site because they are typically based on an occupational scenario with 250 days of exposure per year, which is much greater than would be expected for recreational use at this Site.
  - For surface water, the MDCs were compared to the lower of: (1) EPA's Recommended Chronic AWQC for human consumption of water and fish (EPA 2006), and (2) State of Oregon Human Health Water AWQC for water and fish consumption (ODEQ 2005).
  - The concentration risk screening also evaluated potential cumulative effects of individual COIs across multiple media, as well as multiple COIs within each media and across multiple media.
- In addition to risk from individual COIs in each media, the concentration-risk screening also evaluated potential cumulative effects from exposure to multiple COIs across each media, as well as from exposure to a single COI across multiple media.
  - The risk from exposure to multiple COIs across a single medium is evaluated by dividing each single COI risk ratio by the sum of risk ratios for the medium.
  - A result greater than 1 divided by the number of risk ratios indicates risk.
  - The risk from exposure to a COI across multiple media is evaluated by summing the COI's risk ratio for each medium; a total risk ratio greater than or equal to 1, indicates risk.
- Results of the screening process are summarized in Table 2.
  - Two COPCs were identified: arsenic and iron. Arsenic (inorganic) is a carcinogen, and both arsenic and iron can pose non-carcinogenic health risks at high concentrations.
    - Arsenic was identified as a COPC in all media.
    - Iron was identified as a COPC based on exposure to multiple COIs across multiple media.

4.1.5 Exposure Point Concentrations

- The EPC is used in the risk calculations and is defined as the concentration that a receptor will potentially contact during the exposure period.
  - EPCs were estimated for each COPC from the analytical results of samples collected during the field investigation.
  - For the RME scenario, UCL_{90} concentrations were used for the EPC because of the uncertainty associated with estimating the true average concentration at a Site; however, because of the relatively small data sets and non-parametric data distribution, the computed UCL_{90} concentrations for some COPCs exceeded the MDC. In those instances, the MDC was used as the EPC.
  - For the CTE scenario, the arithmetic mean concentration was used as the EPC for all media in accordance with EPA guidance (EPA 1991).
- The EPCs used in this HRHA are summarized in Table 3.

4.1.6 Exposure Factors and Assumptions

- EFs are assumed variables that are used with EPCs in the risk characterization equations to calculate contaminant exposures based on receptor body weight, exposure frequency and duration, averaging time, intake rates, chemical bioavailability, and other factors.
- The EFs were derived from a combination of site-specific conditions and standard default values presented in risk assessment guidance documents (EPA 1997a & 2004a, ODEQ 2000a) and are summarized in Table 4.

4.2 Toxicity Assessment

- The toxicological properties of COPCs identified in the exposure assessment were evaluated to determine the types and severity of potential health hazards associated with each COPC.
- Toxicological values for use in the risk equations were obtained from:
  - EPA's Integrated Risk Information System (IRIS, EPA 2008)
  - Health Effects Assessment Summary Tables (HEAST, EPA 1997c)
  - U.S. Department of Energy's (DOE) Risk Assessment Information System (RAIS, DOE 2008)
- Although subchronic exposures may be most representative of actual exposure times at the Site, toxicity values for chronic exposure, i.e., from 7 years to a lifetime, were used to be conservative.
- The non-carcinogenic and carcinogenic toxicity values are summarized in the human health risk calculation tables in Attachment A.

4.3 Risk Characterization

- Potential non-carcinogenic hazards, carcinogenic risks, and lead risks to human receptors at the Site were estimated using the EPA risk assessment methodology and equations presented in the following subsections (EPA 1991).

4.3.1 Chronic Daily Intake

- The chronic daily intake (CDI) represents the estimated daily exposure in milligrams per kilogram per day (mg/kg-day) to a contaminant at the Site based on site-specific EFs and other parameters.

- CDIs are calculated for each exposure pathway and media using the following equations:

Ingestion: $$CDI = \frac{CS \times IR \times EF \times ED \times CF}{BW \times AT}$$

Dermal Contact (soil): $$CDI = \frac{CS \times SA \times SSAF \times DAF \times EV \times EF \times ED \times CF}{BW \times AT}$$

Dermal Contact (water): $$CDI = \frac{CS \times SA \times Kp \times EV \times Tev \times EF \times ED \times CF}{BW \times AT}$$

Inhalation: $$CDI = \frac{CS \times IN \times EF \times ED}{BW \times AT \times PEF}$$

Where:

CS = Contaminant concentration (mg/kg or milligram per liter [mg/L])
IR = Ingestion rate (milligram per day [mg/day])
EF = Exposure frequency (day per year)
ED = Exposure duration (year)
EV = Events per day
Tev = Time per event (hour/event)
CF = Conversion factor (kg/mg or liter per cubic centimeter [L/cm^3])
BW = Body weight (kg)
AT = Averaging time (day)
DAF = Dermal absorption factor (unitless)
SA = Skin surface area (square centimeter [cm^2])
SSAF = Soil to skin adherence factor (milligram per square centimeter per day [mg/cm^2/day])
Kp = Dermal permeability coefficient (cm/hr)
IN = Inhalation rate (cubic meter per day [m^3/day])
PEF = Particulate emission factor (cubic meter per kilogram [m^3/kg])

4.3.2 Non-carcinogenic Hazards

- Non-carcinogenic hazards are evaluated by comparing the CDIs for each exposure pathway and media with EPA-established reference doses (RfD).
  - RfDs are COPC-specific toxicological values developed by the EPA to represent route-specific estimates of the safe dosage for each COPC over a lifetime of exposure.
  - Potentially adverse health affects can occur if the CDI exceeds the RfD.
  - RfDs can be classified as chronic or subchronic depending on the length of exposure.
  - Although subchronic RfDs may be more representative of actual site conditions, chronic RfDs represent the highest average daily exposure to a human receptor that will not cause adverse health effects during their lifetime; therefore, to be conservative chronic RfDs were used.

- A non-carcinogenic Hazard Quotient (HQ) is computed for each COPC and exposure pathway by dividing the CDI by the RfD:

$$Non-carcinogenic\ HQ = \frac{CDI}{RfD}$$

Where:

CDI = Chronic daily intake; the estimated exposure over a given time
RfD = Reference dose; the exposure level above which represents potential adverse health effects

- Individual HQs are determined for all COPCs in each exposure pathway.
  - HQ or HI values greater than 1 indicate the potential for adverse health effects because the estimated intake exceeds the safe dosage (EPA 1991).
  - Oregon Administrative Rule (OAR) 340-122-0115 defines the "acceptable risk level for human exposure to non-carcinogens" as an HI of less than or equal to 1 (ODEQ 2000a).
  - Generally, if two or more COPCs have the same target organ or similar effects, their HQs are summed to determine a HI. For example, two COPCs that both have an effect on the liver would be summed into an HI.
  - If one COPC affects the liver and the other COPC affects the central nervous system (CNS), their affects are not considered additive and their HQs are usually not summed into an HI. However, when there is a carcinogenic COPC (such as arsenic) at high concentrations, carcinogenic risk will typically drive the human health risk and non-carcinogenic hazards will not be a factor.
  - Therefore, because arsenic is present at relatively high concentrations at this Site, the individual HQs were conservatively summed into an HI without regard for the target organ.

4.3.3 Carcinogenic Risks

- The carcinogenic risk from exposure to a COPC is expressed in terms of the probability that an exposed receptor will develop cancer over their lifetime.
- Carcinogenic risks are estimated by multiplying the CDIs by COPC-specific slope factors (SF) developed by the EPA:

$$Carcinogenic\ Risk = CDI \times SF$$

Where:

CDI = Chronic daily intake averaged over a lifetime; i.e., the estimated lifetime exposure at the Site
SF = Slope factor; the upper-bound estimate of probability of cancer per unit of intake over a lifetime

- The SF converts the contaminant intake to a risk of developing cancer from the exposure (i.e., ECR). SFs are chemical- and route-specific and represent an upper bound individual lifetime ECR.
  - The ECR from each COPC in an exposure pathway are summed to determine the cumulative risk for each pathway and the cumulative risks from each pathway are summed to determine

the overall site risk.
  - ECRs greater than 1.E-06 indicate carcinogenic risk; however, the EPA suggests considering a range of ECRs from 1.E-06 to 1.E-04 when determining whether risks warrant a removal action (EPA 1991).
  - OAR 340-122-0115 defines the "acceptable risk level for human exposure to individual carcinogens" as an ECR of less than or equal to 1.E-06 (ODEQ 2000a).

4.3.4 Lead Risks

- Risks from exposure to lead cannot be quantified using standard risk assessment algorithms because the EPA has not established lead RfDs and SFs.
- The EPA currently recommends two models (IEUBK and Adult Lead Methodology [ALM]) for assessing lead risk based on the receptor age group; however, both models were developed to assess exposures under chronic, steady-state conditions such as a working environment, school, or residence (EPA 2002 and 2005a).
  - The models are not intended to be used for acute, short-term exposures such as those associated with occasional recreational use of a remote site.
  - Because exposures at the Site are expected to be short-term and occasional, the lead exposure models were not used and lead risks were not quantitatively evaluated.
- Therefore, lead risks were qualitatively evaluated by comparing the maximum detected lead concentrations at the Site to EPA and Oregon State human health screening criteria.
  - The maximum detected lead concentration (194 mg/kg) at the Site is well below the EPA Industrial Soil PRG (800 mg/kg, EPA 2004b), and Oregon's Industrial Maximum Allowable Soil Concentration Cleanup Level (2,000 mg/kg, ODEQ 2000b).
  - There does not appear to be a human health risk from exposure to lead at the Site.

4.4 Uncertainty Analysis

- The estimates of exposure, non-carcinogenic hazard, and carcinogenic risk presented in this HHRA are subject to varying degrees of uncertainty from a variety of sources, including site data, exposure assessment, and risk characterization.

4.4.1 Site Data

- The size of the data set, sample locations, and sample analyses can all contribute uncertainty to the risk assessment.
  - In general, smaller data sets lend more statistical variability to estimates of contaminant concentrations and may over- or underestimate the true mean or maximum concentration.
  - Also, background concentrations were based on very small data sets (four or fewer samples) and may not be representative of actual background conditions. Use of these background concentrations to screen COIs may result in screening out potential contaminants that could be above true background levels.
- The intent of sampling during a field investigation is typically to determine metals concentrations in areas of suspected contamination, such as mine waste piles and adit discharges.
  - Based on the methodology used for sample collection during the field investigation, the samples are expected to be biased to the highest concentrations present on the Site and do not represent an average Site concentration. Therefore, exposure doses based on the results of these non-random samples are expected to be biased to the upper end of the range of exposures at the Site.

- The analytical suite was limited to COIs typically found at other mine sites in the region; risks from exposure to organics at this Site were not characterized in this HHRA.

4.4.2 Exposure Assessment

- Many of the factors used to estimate exposure rates at the Site are standard assumptions based on EPA HHRA guidance values and may not accurately describe future site conditions or uses.
  - The assumed receptors were limited to an adult worker and adult and child recreationalists.
  - The recreational exposure frequencies are based on very limited use because of the remoteness of the Site and the absence of nearby developed recreational areas. However, the assumed exposure duration of 30 years for the adult under the RME scenario may overestimate actual use since it is unlikely that a recreationalist will revisit the Site for 30 consecutive years.
- The anticipated recreational activities do not generally result in significant dermal contact or ingestion of sediment. Inclusion of these exposure pathways likely contributes additional conservatism to the HHRA.
- It is inherently assumed that future COPC concentrations will remain the same as current concentrations.

4.4.3 Toxicity Assessment

- Uncertainties are inherent in toxicity factors because of several factors, including statistical extrapolation, population variability, and limited biological and epidemiological studies. These uncertainties may contribute to under- or overestimation of potential risks and hazards.

4.4.4 Risk Characterization

- The standard algorithms used to calculate the contaminant intakes and associated health risks and hazards add uncertainty to the risk assessment.
  - The algorithms assume the additivity of toxic effects for multiple contaminants and do not account for synergistic or antagonistic effects.
  - Concurrent exposure to multiple pathways by a single receptor and the associated cumulative risks and hazards also is assumed which likely overestimates actual exposures.
  - The algorithms also do not account for factors such as absorption or matrix effects.

4.4.5 Lead Risk

- Because of the lack of established quantitative reference data for lead, potential health risks from exposure to lead at the Site were not quantified; therefore, the potential risks were qualitatively evaluated by comparing lead concentrations in mine waste and surface water samples to suggested screening values and may or may not be representative of actual risks.
  - The EPA screening value (Region IX Industrial Soil PRG, EPA 2004b) is based on a worker scenario with 250 days of exposure and application of this screening level should provide a very conservative estimate of lead risk at the Rabbit Mine where the adult recreationalist exposure is based on 30 days per year under the RME scenario.

4.5 Summary of Potential Human Health Risks

- The estimated non-carcinogenic hazards and carcinogenic risks from exposure to COPCs at the Rabbit Mine are summarized in Table 5.

- The estimated non-carcinogenic hazards were compared to the EPA and Oregon acceptable level of HI $\leq$ 1 (EPA 1991, ODEQ 2000a).
  - The results indicate minimal (i.e. HI $\leq$ 1) non-carcinogenic hazard for all receptors under both the CTE and RME scenarios.
- The estimated carcinogenic risks from exposure to COPCs at the Rabbit Mine were compared with EPA's suggested screening ECR range of 1.E-06 to 1.E-04 (EPA 1991), and ODEQ's acceptable carcinogenic risk level of $\leq$ 1.E-06 for a single carcinogen (ODEQ 2000a).
  - The results indicate a very low carcinogenic risk (1.E-06) to the adult worker under the CTE scenario, and a moderate carcinogenic risk all receptors under the RME scenario.
  - The total cumulative ECR for both the child and adult recreationalist was 1.E-05 under the RME scenario.
  - The total cumulative ECR to the adult worker was 9.E-05 under the RME scenario.

- Incidental ingestion of and dermal contact with arsenic in the mine waste are the most significant exposure pathways and contribute the majority of carcinogenic risk at the Site. There is also moderate carcinogenic risk to the adult worker from dermal contact with arsenic in the sediment.
  - Dermal contact with and ingestion of surface water and inhalation of particulates from the mine waste contributed minimally to the overall risk and, therefore, are not considered to be significant exposure pathways at the Site.
- Human health risks resulting from exposure to lead at the Site were not quantified because (1) the EPA has not established quantitative reference data for lead, and (2) the current lead exposure models are based on chronic long-term exposures and are not intended for assessing risk from occasional short-term exposures.
  - Therefore, the potential risks from exposure to lead were qualitatively evaluated by comparing lead concentrations in mine waste, sediment, and surface water samples to establish suggested screening levels for the protection of human health.
    - The EPA has not specified a hazardous waste threshold value for total lead in soil and has not established a drinking water maximum contaminant level (MCL) for lead; however, it suggests lead screening levels of 800 mg/kg for industrial soils and 15 micrograms per liter (μg/L) for drinking water.
    - The maximum detected lead concentration in mine waste at the Site was 194 mg/kg, which is well below the screening level.
    - In sediment, the maximum detected lead concentration was only 5.5 mg/kg, which is well below the screening level.
    - In surface water, lead was not detected in any of the samples.
    - There does not appear to be a human health risk from exposure to lead at the Site.

4.6 Hot Spot Assessment

- Hot spots are defined by Oregon's Environmental Cleanup Rules (OAR 340-122) as areas where the contamination is "highly concentrated, highly mobile, or cannot be reliably contained" (ODEQ 1998).
  - These hot spots often cover a relatively small area but contribute to a large percentage of the overall site contamination and exposure risk.
  - OAR 340-122 also defines "highly concentrated" as concentrations corresponding to a non-carcinogenic HQ of 10 or an ECR of 1E-04 (ODEQ 2000a).
- Results of the HHRA indicate potential significant human health risks at the Site from exposure to arsenic in the mine waste and sediment; therefore, a hot spot assessment was conducted to identify specific areas contributing a large percentage of the overall site risk.
  - Hot spot concentrations for arsenic in mine waste and sediment were back-calculated using

the HHRA risk equations and an acceptable ECR of 1.E-04 and a non-cancer HI of 10 for the most sensitive receptor (adult worker). The hot spot risk levels (HI = 10 and ECR = 1.E-04) are entered into the risk equations and a corresponding hot spot arsenic concentration is back-calculated.
    - Areas where mine waste samples contained arsenic concentrations exceeding the calculated hot spot concentrations are considered to be hot spots.
    - The hot spot concentrations are summarized in Table 6.
        - Arsenic exceeded the soil hot spot concentration (460 mg/kg) in two mine waste samples (WR5-RT-G-01 and WR6-RT-G-01) from the southeast face of waste rock pile WR1.
        - Based on these results, waste rock pile WR1 is considered to be the only mine waste hot spot at the Site.
- None of the sediment samples exceeded the arsenic hot spot concentration of 1,160 mg/kg.

4.7 Human Health Risk-based Cleanup Levels

- Because results of the HHRA indicated potential significant human health risks at the Site, risk-based cleanup levels were developed for mine waste and sediment at the Site.
- Cleanup levels for arsenic in mine waste and sediment were back-calculated using the HHRA risk equations and an acceptable non-carcinogenic HI of $\leq$ 1 and a carcinogenic ECR of 1.E-05 for the most sensitive receptor (adult worker) under the RME scenario. The cleanup risk levels (HI = 1 and ECR = 1.E-05) are entered into the risk equations and a corresponding arsenic cleanup concentration is back-calculated.
- No cleanup levels were established for surface water because they typically default to state or federal water quality criteria, such as EPA MCLs, and surface water does not pose a human health risk at the Site.
- The risk-based cleanup levels are summarized in Table 6.
    - Arsenic was above the mine waste cleanup level (46 mg/kg) in a total of seven mine waste samples from two different areas:
        - Waste rock pile WR1, maximum detected arsenic concentration = 1,280 mg/kg
        - Soil around the mill foundation, maximum detected arsenic concentration = 69.1 mg/kg
    - No sediment samples exceeded the arsenic cleanup level of 116 mg/kg.

5.0 STREAMLINED ECOLOGICAL RISK ASSESSMENT

- A streamlined ecological risk assessment (ERA) was completed to assess potential risks to ecological receptors from exposure to waste rock and contaminated media at the Rabbit Mine.
- The ERA was conducted in general accordance with state and federal regulations and guidelines, including:
    - CERCLA
    - SARA
    - NCP 40CFR 300.415(b)(4)(i)
    - EPA's *"Risk Assessment Guidance for Superfund Volume II – Environmental Evaluation Manual,"* (2001)
    - EPA's *"Region 10 Supplemental Ecological Risk Assessment Guidance for Superfund,"* (1997b)
    - EPA's *"Guidelines for Ecological Risk Assessment"* (EPA 1998)
    - ODEQ's *"Guidance for Ecological Risk Assessment,"* (2001)
    - Oregon Administrative Rules (OAR) 340-122-084, Sections 010 through 115

- The streamlined ERA consists of two levels:
  - **Level 1 Scoping ERA:** Qualitatively determines whether there are potential ecological receptors or exposure pathways at the Site and involves examining the ecological setting and identifying sensitive environments, threatened and endangered (T&E) species, and ecological stressors.
  - **Level 2 Screening ERA**: Involves reviewing exposure pathways and receptors present at the Site, determining assessment and measurement endpoints, identifying contaminants of potential ecological concern (CPEC), calculating EPCs, characterizing ecological risks, and evaluating uncertainties associated with the ERA.

5.1 Level 1 Scoping Ecological Risk Assessment

- The objective of the Level 1 Scoping ERA is to qualitatively determine whether there are any potential ecological receptors or exposure pathways at the Site.
- It requires an examination of the ecological setting of the Site, presence of sensitive environments, presence of T&E species, ecological stressors (i.e., COIs), and the development of an ecological Conceptual Site Exposure Model (CSEM).
- The Level 1 Scoping ERA consisted of three steps:
  - **Step 1** – Identify ecological setting, sensitive environments, and T&E species
  - **Step 2** – Identify COIs
  - **Step 3** – Develop an ecological CSEM

5.1.1 Ecological Setting, Sensitive Environments, and T&E Species

- Ecological setting:
  - Located in the Wallowa-Whitman National Forest within the Blue Mountains Ecoregion, near the top of a small drainage that ranges in elevation from 5,800 to 6,200 feet above mean sea level.
  - Shallow groundwater and seasonal springs originating from the air shaft at the Site form an unnamed, first order, intermittent tributary to Olive Creek.
  - Terrestrial habitats in the vicinity of the Site include steep woodland hillsides and a mature riparian habitat along the intermittent stream.
  - An ODEQ ecological scoping checklist was completed by MSE during the field investigation conducted in June 2008 and is included in Attachment C.
  - An aquatic survey of the Site was conducted during the field investigation and is discussed in the SI report.
- Sensitive Environments:
  - A sensitive environment is defined in OAR 340-122-115 as, "an area of particular environmental value where a hazardous substance could pose a greater threat than in other non-sensitive areas. Sensitive environments include but are not limited to: critical habitat for federally endangered or threatened species; National Park, Monument, National Marine Sanctuary, National Recreational Area, National Wildlife Refuge, National Forest Campgrounds, recreational areas, game management areas, wildlife management areas; designated federal Wilderness Areas; wetlands (freshwater, estuarine, or coastal); wild and scenic rivers; state parks; state wildlife refuges; habitat designated for state endangered species; fishery resources; state designated natural areas; county or municipal parks; and other significant open spaces and natural resources protected under Goal 5 of Oregon's Statewide Planning Goals."
    - Based on this definition, there are no sensitive environments within 2 miles of the Site.

- T&E Species:
  - T&E species are those listed as threatened or endangered under the federal Endangered Species Act 16 U.S.C. Section 1533, or classified as threatened and endangered by the State Fish and Wildlife Commission under Oregon Revised Statute 496.171-496.192.
  - "Information regarding T&E species and SOC for wildlife and plant species occurring in Blue Mountains Ecoregion was obtained from the Oregon Department of Fish and Wildlife (ODFW 2008) and the Oregon National Heritage Program (ONHP 2007).
    - Animal and plant species listed as T&E within the Wallowa-Whitman National Forest and specifically Grant County are listed in the SI report and include the bald eagle and the Canada lynx.
    - No T&E species are documented as inhabiting the Site and none were observed during the field investigation conducted by MSE in June 2008. Additionally, because of the small size of the Site, it is likely the Site represents little more than a fraction of the aforementioned species' habitat.

5.1.2 Contaminants of Interest

- Identification of COIs for ecological receptors requires a separate process than used for the HHRA because while some contaminants may not present a risk to human health, they may pose an ecological risk.
- A preliminary list of COIs was identified based on analytical results and a potential risk to ecological receptors: antimony, arsenic (III, V, and total), cadmium, chromium (total), copper, iron, lead, mercury, nickel, silver, and zinc.
- During the Level 2 Screening ERA discussed in Section 5.2, COIs are examined further to identify CPECs posing risk to ecological receptors at the Site.

5.1.3 Ecological Conceptual Site Exposure Model

- An ecological CSEM illustrates the general understanding of the sources of contamination, release and transport mechanisms, impacted exposure media, potential exposure routes, and ecological receptors at the Site.
- Like the human health CSM, the CSEM provides a framework for assessing risk by identifying the following:
  - Environmental setting and contaminants known or suspected to exist at the Site
  - Contaminant fate and transport mechanisms at the Site
  - Mechanisms of toxicity associated with contaminants and potential receptors
  - Complete exposure pathways the Site
  - Potentially exposed populations
- The Rabbit Mine CSEM, shown in Figure 2, is intended to be representative of current and likely future conditions at the Site.
  - The primary source of CPECs at the Site is the waste rock piles.
    - Precipitation could result in the following release/transport mechanisms from the piles of waste rock: runoff, leaching, percolation, or infiltration into surface or subsurface soils, groundwater, or surface water.
  - CPECs in the intermittent stream can follow a similar pathway.
    - Once in the surface water, CPECs can be deposited to sediment or transported downstream as a dissolved constituent, or attached to suspended sediment.
  - Therefore, potential exposure media at the Site includes waste rock, soil, sediment, pore water, and surface water.

5.2 Level 2 Screening Ecological Risk Assessment

- The Level 2 Screening ERA involves evaluating data collected during the field investigation and identifying those contaminants and media that pose potential risks to ecological receptors at the Site.
- The Level 2 Screening ERA consisted of six steps:
  - **Step 1** – Summarizing the potential exposure pathways and receptors present at the Site
  - **Step 2** – Identifying assessment and measurement endpoints
  - **Step 3** – Calculating EPCs
  - **Step 4** – Identifying CPECs
  - **Step 5** – Characterizing ecological risks
  - **Step 6** – Evaluating uncertainties

5.2.1 Potential Exposure Pathways and Receptors

- Potential ecological exposure pathways at the Site and evaluated in this ERA include:
  - Incidental ingestion of soil (waste rock) and sediment;
  - Direct contact with soil (waste rock), sediment, pore water, and surface water; and
  - Ingestion of surface water.
- Potential ecological receptors at the Site are expected to include terrestrial wildlife (plants, birds, invertebrates, reptiles and amphibians, and mammals) and aquatic invertebrates. Fish are not expected to be at the Site because the small intermittent stream does not provide a viable habitat.

5.2.2 Ecological Endpoints

- Identification of ecological endpoints guides the completion of the risk characterization portion of the ERA.
- Assessment and measurement endpoints for this ERA were developed based on the CSEM for the Site.
  - The EPA defines an assessment endpoint as a "formal expression of an actual environmental value to be protected… an environmental value which would indicate a need for remediation."
    - The assessment endpoints for this ERA included survival and reproductive success of terrestrial receptors (invertebrates, birds, mammals, and vegetation).
  - The EPA defines a measurement endpoint as a "quantitative expression of an observed or measured effects of a hazard; and, these measurable environmental characteristics are related to the valued characteristics chosen as assessment endpoints."
    - Typically, the measurement endpoint will dictate the type of samples and/or data to be collected and assessed to address the affect of stressors on the ecological receptors.
    - However, because the data has already been collected, the measurement endpoint for this ERA consisted of a comparison of the measured concentrations of the COIs in soil, waste rock, surface water, and sediment to their respective ecological risk-based SLVs.

5.2.3 Exposure Point Concentrations

- Ecological receptors do not experience their environment on a "point" basis; therefore, it is necessary to convert measured data from single sample points into an estimate of concentration over their habitat to conduct an appropriate risk screening.

- For this ERA, EPCs were based on either the MDC or UCL_{90} concentration from the analytical results, depending on the ecological receptor as suggested by ODEQ ecological risk assessment guidance (2001) and are as follows:
  - For invertebrates (such as worms) and plants, the MDC was used as the EPC, and
  - For birds, aquatic life, and mammals, the UCL_{90} was used as the EPC.
  - In some cases, because of the small sample number, the UCL_{90} was unable to be calculated. In those cases, the MDC was used as the EPC.

5.2.4 Contaminants of Potential Ecological Concern

- The COIs identified in the Level 1 Scoping ERA were screened through four processes to identify CPECs:
  - Preliminary screening
  - Chemistry-toxicity screening
  - Bioaccumulation screening
  - SLV availability screening

5.2.4.1 Preliminary Screening

- In accordance with EPA guidance (1997b) and ODEQ guidance (2001), the COIs identified in the Level 1 Scoping ERA were screened and removed from further analysis if they exhibited one or more of the following characteristics:
  - Qualified as an essential nutrient and did not have a media-specific ODEQ SLV (ODEQ 2001),
  - Were detected in fewer than 5 percent of the samples by media type, or
  - Were present in concentrations below background concentrations.
- The preliminary screening results are summarized in Tables 7 through 11.

5.2.4.2 Chemistry-toxicity Screening

- COIs remaining following the preliminary screening were subjected to chemistry-toxicity screening which involved assessing potential ecological risks by comparing the EPCs to ecological risk-based SLVs.
- When available, SLVs were obtained from ODEQ's Level II SLVs for Plants Invertebrates, and Wildlife (ODEQ 2001). Screening values were also obtained from the EPA for comparison.
- A chemistry-toxicity screen was performed based on the following conditions:
  - Exposure to a single COI in an exposure medium
  - Exposure to multiple COIs in an exposure medium
  - Exposure to individual COIs in multiple exposure media
- Potential ecological risk from exposure to a single COI in an exposure medium was assessed by calculating contaminant-specific risk ratios (T_{ij}). Risk ratios for each COI were calculated using the following equation:

$$T_{ij} = \frac{C_{ij}}{SLV_{ij}}$$

Where:

T_{ij} = Risk ratio of COI *i* in medium *j*
C_{ij} = Contaminant concentration of COI *i* in medium *j* (mg/kg or mg/L)
SLV_{ij} = Screening level value for COI *i* in medium *j* (mg/kg or mg/L)

- The risk ratios were compared to receptor-specific risk ratios (Q-factors) to evaluate potential ecological risk.
  - In general, higher risk ratios present a greater likelihood that a CPEC concentration will adversely affect ecological receptors.
  - Risk ratios greater than 1 (Q > 1) indicate potential risk for protected (i.e., federally listed) T&E species.
  - Risk ratios greater than 5 (Q > 5) indicate potential risk to non-protected receptors.
  - No T&E species are documented as inhabiting the Site and none were observed during the field investigation conducted by MSE in June 2008; therefore, an acceptable Q-factor of 5 was used for mammals, birds, plants, invertebrates, and aquatic life.

If $T_{ij} \geq Q$ retain COI *i* as a CPEC in medium *j*,

Where:

T_{ij} = Risk ratio of COI *i* in medium *j*
Q (Receptor-specific risk ratio) = 5 for non-protected species (invertebrates, birds, mammals, and aquatic life)

- For exposure to multiple COIs in a single exposure medium, the potential ecological risk was assessed by calculating the ratio of a contaminant-specific risk ratio to the overall risk (sum of all contaminant-specific risk ratios) presented in a medium:

If $\frac{T_{ij}}{T_i} \geq \left(\frac{Q}{N_{ij}} \right)$ retain COI *i* as a CPEC in medium *j*

Where:

T_{ij} = Risk ratio of COI *i* in medium *j*
T_j = Sum of risk ratios (T_{ij}) from all COIs to each receptor group
Q = Receptor-specific risk ratio, = 5 for non-protected species
N_{ij} = Number of COIs with risk ratios (T_{ij}) for each receptor group

- If a COI was detected in multiple media, it was retained as a CPEC if the sum of risk ratios exceeded the receptor-specific risk ratio:

If $\sum_{j=1}^{j} T_{ij} \geq Q$ retain COI *i* as a CPEC

Where:

T_{ij} = Risk ratio of COI *i* in medium *j*
Q = Receptor-specific risk ratio, = 5 for non-protected species

- The results of the chemistry-toxicity screen are presented in the ecological risk calculation tables in Attachment B, and summarized below according to exposure media. The screening results and identified CPECs are presented in Tables 7 through 11.

- **Waste rock:** Five CPECs were identified in waste rock from single COI risk ratios: cadmium, iron, lead, mercury, and zinc. Of these, only iron showed risk from multiple COIs. Five additional CPECs were retained because of the lack of SLVs: antimony, arsenic (V and total), chromium total, and silver.
- **Surface Water:** No CPECs were identified in surface water from single or multiple COI risk ratios; however, arsenic (V and total) was retained because of the lack of SLVs.
- **Sediment:** Three CPECs were identified in sediment: cadmium, copper, and zinc. Arsenic (total) and mercury were retained as CPECs because of the lack of SLVs.
- **Pore Water:** No CPECs were identified in pore water from single or multiple COI risk ratios; however, arsenic (total) was retained because of the lack of an SLV.

5.2.4.3 Bioaccumulation Screening

- According to OAR 340-122-084(3)d, special attention must be given to COIs that are, or are suspected of being, persistent bioaccumulative toxins (such as mercury).
- Bioaccumulative toxins can compromise food chains and induce adverse effects in higher trophic level species.
- In the suite of COIs identified for this ERA, metals with the most bioaccumulative potential in each medium include the following:
  - Waste rock: cadmium, copper, mercury, silver, and zinc
  - Sediment: cadmium, copper, and zinc
  - Pore water and surface water: none

5.2.4.4 SLV Availability Screening

- In some instances, SLVs were not available for a given COI-media-receptor combination.
- Because estimating the toxicity or bioaccumulative potential of the COI was not possible, the COI was retained as a potential CPEC.
- The COIs retained as CPECs because of the lack of SLVs are shown in Tables 7 through 11.

5.3 Ecological Risk Characterization

- The results of the CPEC screening discussed above provide an approximate level of potential ecological risk at the Site.
- Risk characterization is comprised of describing the risks to ecological receptors and the uncertainties in the ERA.
  - The objective of the ecological risk description is to assess whether the predicted risks are likely to occur at the Site.
  - The objective of the uncertainties analysis is to examine the data gaps or sources of variability in the ERA process and whether these uncertainties underestimate or overestimate the ecological risks at the Site. The uncertainty evaluation is described in Section 5.4 of this report.
- The ecological risk ratio calculation tables presented in Attachment B, and the results are summarized in Table 12.

5.3.1 Mine Waste

- Ecological risk calculations for mine waste at the Site indicate the following:
  - Iron, lead, and mercury are the most significant CPECs because they pose a potential threat to

more than one ecological receptor group (plants and invertebrates).

- Based on an acceptable risk ratio of Q = 5 for non-protected species, no CPECs were determined to pose a potential threat to mammals or birds.
  - Five CPECs were identified for mammals because of the lack of SLVs: arsenic (V and total), chromium (total), iron, and silver.
  - Six CPECs were identified for birds because of the lack of SLVs: antimony, arsenic (V and total), chromium (total), iron, and silver.
- Two CPECs pose a risk ratio to invertebrates based on an acceptable risk ratio of Q = 5 for non-protected species: iron (Q = 431) and mercury (Q = 26).
  - Four additional CPECs were identified for invertebrates because of the lack of SLVs: antimony, arsenic (V and total), and chromium (total).
- Three CPECs pose a risk to plants based on an acceptable risk ratio of Q = 5 for non-protected species: iron (Q = 8,610), mercury (Q = 9), and zinc (Q = 5.4).
  - Three additional CPECs were identified for plants because of the lack of SLVs: arsenic (V and total), and chromium (total).
- Iron posed a multiple COI risk to both plants and invertebrates.
  - No other CPECs posed a multiple COI risk to receptors.

5.3.2 Surface Water

- Ecological risk calculations for surface water at the Site indicate the following:
  - Based on an acceptable risk ratio of Q = 5 for non-protected species, no CPECs were identified in surface water as posing a risk to birds, mammals, or aquatic life from single or multiple COI risk ratios.
    - Arsenic (V and total) and copper were retained as CPECs to aquatic life because of the lack of SLVs.

5.3.3 Sediment

- Ecological risk calculations for sediment at the Site indicate the following:
  - Three CPECs were identified as posing a risk to aquatic life based on an acceptable risk ratio of Q = 5 for non-protected species: cadmium, copper, and zinc.
    - None of the three CPECs were identified as posing a freshwater sediment risk.
    - The highest risk is from the bioaccumulation of cadmium (Q = 73).
    - There is also moderate risk from bioaccumulation of zinc (Q = 15) and copper (Q = 6).
    - Arsenic (total) was retained as both a freshwater sediment and bioaccumulation CPEC because of the lack of SLVs.
    - Mercury was retained as a bioaccumulation CPEC because of the lack of an SLV.

5.3.4 Pore Water

- Ecological risk calculations for pore water at the Site indicate the following:
  - Based on an acceptable risk ratio of Q = 5 for non-protected species, no CPECs were identified in pore water as posing a risk to aquatic life from single or multiple COI risk ratios.
  - Arsenic (total) was retained as a CPEC to aquatic life because of the lack of an SLV.

5.4 Uncertainty Evaluation

- There are several sources of potential uncertainty associated with this ERA.
  - These sources and their potential impact on the prediction of potential risks to ecological receptors at the Site are discussed below.

5.4.1 Sample Data

- The selection of sampling media, sample locations, quantity of samples, sampling procedures, and sample analysis introduce some uncertainties into this ERA.
  - Time and monetary restraints limit the number of samples that can be collected; therefore, sample locations are selected based on knowledge of anticipated presence of particular contaminants.
  - Overall, the data used in this ERA were generally collected from areas with expected elevated metals concentrations. As a result, this assessment likely overestimates the risk posed to ecological receptors at the Site.

5.4.2 Screening Level Values

- The ecological risk-based SLVs used in this ERA are intended to be no-observed-adverse-effects-levels (NOAEL), with the exception of sediment SLVs.
- Ecological effects occur at some concentration between the NOAELs and the lowest-adverse-effects-levels (LOAEL); therefore, concentrations exceeding the SLV do not necessarily constitute a "real" risk for ecological receptors.
  - Thus, use of NOAEL-based SLVs results in an overestimation of actual ecological risks at the Site.
- The lack of established SLVs for several COIs was another source of uncertainty in the ERA. COIs retained as CPECs because of the lack of SLVs rather than because of high-risk ratios may result in an overestimation of the overall potential for ecological risk at the Site.

5.4.3 CPEC Selection

- No pore water or sediment background samples were collected; thus, no CPEC background concentration screening for pore water and sediment was conducted.
- As a result, inclusion of contaminants that may actually be below background levels during the screening process may result in overestimating actual risks.
- In addition, the use of the MDC or UCL_{90} as the EPC may inherently introduce conservatism and contribute to overestimation of risk at the Site.

5.4.4 Home Range

- The use of SLVs assumes that the receptor's habitat is restricted to the affected area represented by the EPC.
  - These areas typically offer lower habitat quality compared to adjoining habitat and it is unlikely that a receptor would limit its habitat strictly to these areas.
  - The home range for most birds and mammals covers an area much larger than the Site.
- Because of the relatively small area of the piles of waste rock, the use of the SLVs likely overestimates the actual risk.

5.5 Summary of Potential Ecological Risks

- Results of the streamlined ERA indicate potential risk to ecological receptors at the Rabbit Mine and are summarized in Table 12.
- Risks from mine waste:
  - Risk posed to birds and mammals from exposure to mine waste is not elevated (Q < 5).
    - However, six COIs (antimony, arsenic [V and total], chromium total, iron, and silver) were retained as CPECs because of the lack of screening level values.
  - Plants are the most susceptible ecological group to metal concentrations in the soil and waste rock piles.
    - The primary CPECs for the soil-plant combination exhibit elevated concentrations across the Site or have the potential to bioaccumulate and include iron, mercury, and zinc.
    - The CPEC with the highest risk ratio and thus poses the highest risk to plants was iron (Q = 8,610)
    - Arsenic (V and total) and chromium total were retained as CPECs because of the lack of screening level values.
  - The primary CPECs for terrestrial invertebrates are iron and mercury.
    - Iron also poses the highest risk to terrestrial invertebrates (Q = 431).
    - Antimony, arsenic (V and total), and chromium total were retained CPECs because of the lack of screening level values.
- Risks from surface water:
  - Risk posed to birds, mammals, and aquatic life from exposure to contaminated surface water is not elevated (Q < 5).
    - However, arsenic (total and V) were retained as CPECs because of the lack of screening level values.
- Risks from sediment:
  - Three sediment CPECs were identified as posing a risk to aquatic receptors from either direct exposure or bioaccumulation (cadmium, copper, and zinc).
    - The highest risks are from the bioaccumulation of cadmium (Q = 73) and zinc (Q = 15).
  - Arsenic (total) and mercury were also retained as CPECs because of the lack of screening level values.
- Risks from pore water:
  - No CPECs were identified for pore water based on risk ratios; however, arsenic (total) was identified as a CPEC because of the lack of a screening level value.
- The risks identified as part of this assessment appear to be limited to individual receptors and there does not appear to be significant population-level risks.
  - While individual receptors may be at risk from exposure to CPECs at the Site, their populations are unlikely to be significantly impacted in the vicinity of the mine because it is unlikely that entire populations would reside entirely within the contaminated areas of the Site.
  - In the case of mammals, birds, and terrestrial invertebrates, it should be noted that these affected areas typically offer lower habitat quality compared to adjoining habitat; therefore, it is unlikely that a receptor would limit its habitat strictly to these areas.

6.0 CONCLUSIONS

- Results of the streamlined RAs indicate significant potential risks to both human and ecological receptors at the Site.
- The HHRA indicates carcinogenic risk from exposure to arsenic in the mine waste and sediment

at the Site.
  - Two human health COPCs were identified: arsenic and iron.
  - The most significant exposure pathway is ingestion of and dermal contact with the mine waste.
  - Inhalation of particulates from the mine waste, incidental ingestion of surface water and sediment, and dermal contact surface water at the Site contribute minimal risk and are insignificant pathways.
- A hot spot assessment was completed and hot spot concentrations for arsenic in soil and sediment were back calculated using the human health risk equations based on the most sensitive receptor (adult worker) under the RME scenario and a hot spot carcinogenic risk level of 1.E-04 for total cumulative risk.
  - Arsenic exceeded the soil hot spot concentration of 460 mg/kg in two mine waste samples from one area: the southeast face of waste rock pile WR1 (723 and 1,280 mg/kg).
  - No sediment samples exceeded the arsenic hot spot concentration of 1,160 mg/kg.
- Human health risk-based cleanup levels were also calculated for arsenic in soil and sediment based on the most sensitive receptor (adult worker) under the RME scenario and an acceptable carcinogenic risk level of 1.E-05 for total cumulative risk.
  - Seven mine waste samples from two areas exceeded the arsenic cleanup level of 46 mg/kg:
    - Waste rock pile WR1, maximum detected arsenic concentration = 1,280 mg/kg
    - Soil around the mill foundation, maximum detected arsenic concentration = 69.1 mg/kg
  - No sediment samples exceeded the arsenic cleanup level of 116 mg/kg.
- Removal of mine waste with arsenic concentrations exceeding the cleanup level should significantly reduce both the overall human health and ecological risk at the Site.
  - The total volume of waste rock in the two areas exceeding cleanup levels is estimated to be about 3,070 bank cubic yards (bcy).
- Results of the streamlined ERA indicate significant potential risk to plants, terrestrial invertebrates, and aquatic life at the Site; however, there does not appear to be a risk to birds or mammals.
  - Risks appear to be limited to individual receptors rather than whole populations. This is because: (1) the home range for most receptors is significantly larger than the Site and it is improbable that entire populations of receptors reside strictly within the Site boundaries, and (2) the Site likely represents suboptimal habitat compared to the surrounding area.
  - Several CPECs were identified and the highest risk ratios for plant and terrestrial invertebrates are from exposure to iron and mercury in the mine waste.
  - There is also potential risk to aquatic receptors from bioaccumulation of metals resulting from exposure to sediment, particularly cadmium, copper, and zinc.

DISCLAIMER

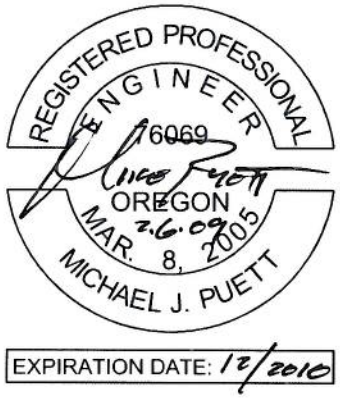
This abandoned mine/mill site was created under the General Mining Law of 1872 and is located solely on National Forest System (NFS) lands administered by the Forest Service. The United States has taken the position and courts have held that the United States is not liable as an "owner" under CERCLA Section 107 for mine contamination left behind on NFS lands by miners operating under the 1872 mining law. Therefore, USFS believes that this Site should not be considered a "federal facility" within the meaning of CERCLA Section 120 and should not be listed on the Federal Agency Hazardous Waste Compliance Docket. Instead, this Site should be included on EPA' CERCLIS database. Consistent with the June 24, 2003 OECA/FFEO "Policy on Listing Mixed Ownership Mine or Mill Site Created as a Result of the General Mining Law of 1872 on the Federal Agency Hazardous Waste Compliance Docket," we respectfully request that the EPA Regional Docket Coordinator consult with the Forest Service and EPA Headquarters before making a determination to include this Site on the Federal Agency Hazardous Waste Compliance Docket.

Prepared by:

Millennium Science and Engineering, Inc.

Leslie Eldridge, P.E.
Principal Author

Michael Puett, P.E.
Technical Reviewer



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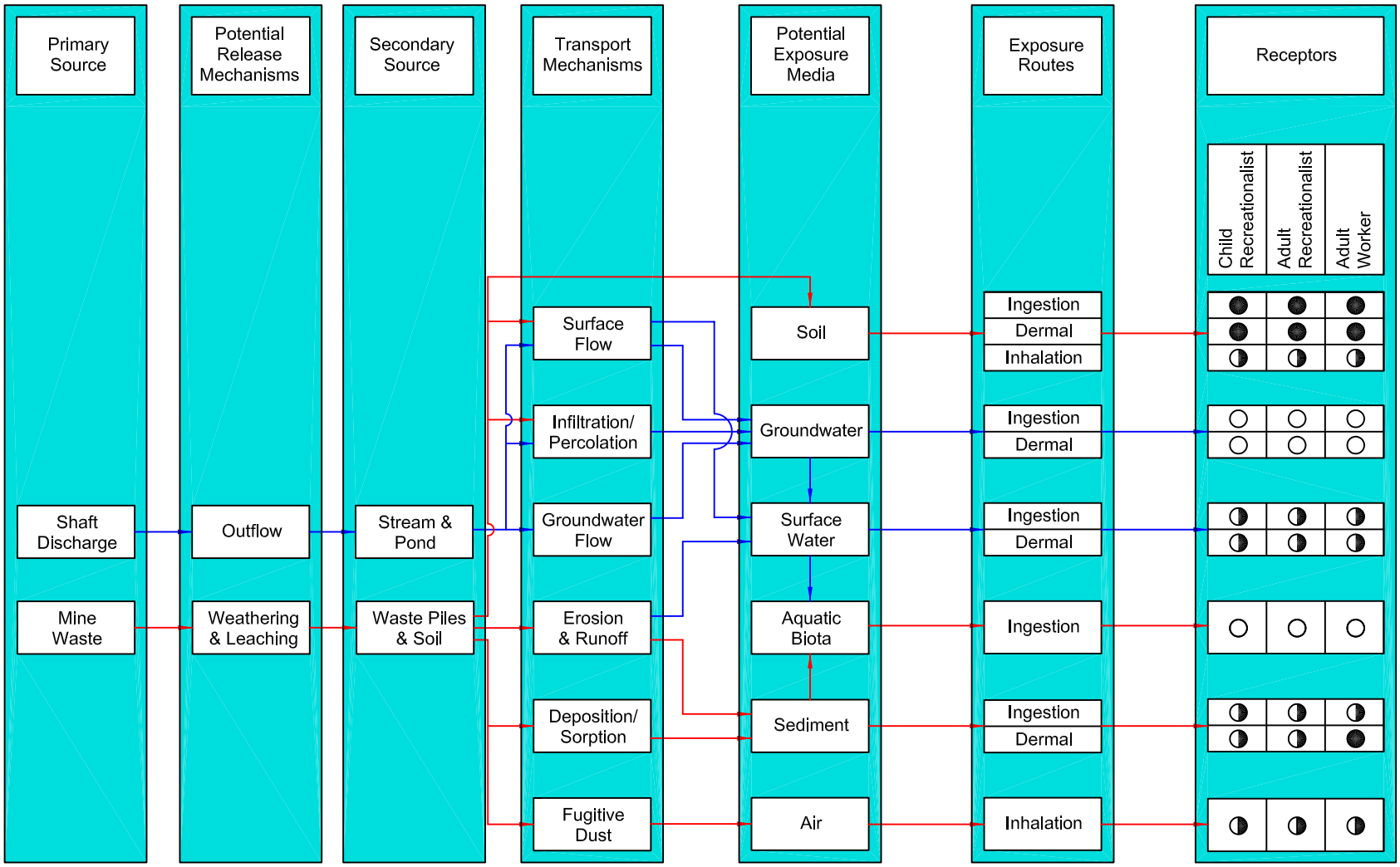
U.S. Forest Service. 2004. *"Abbreviated Preliminary Assessment, Rabbit Mine and Mill."* March.

FIGURES



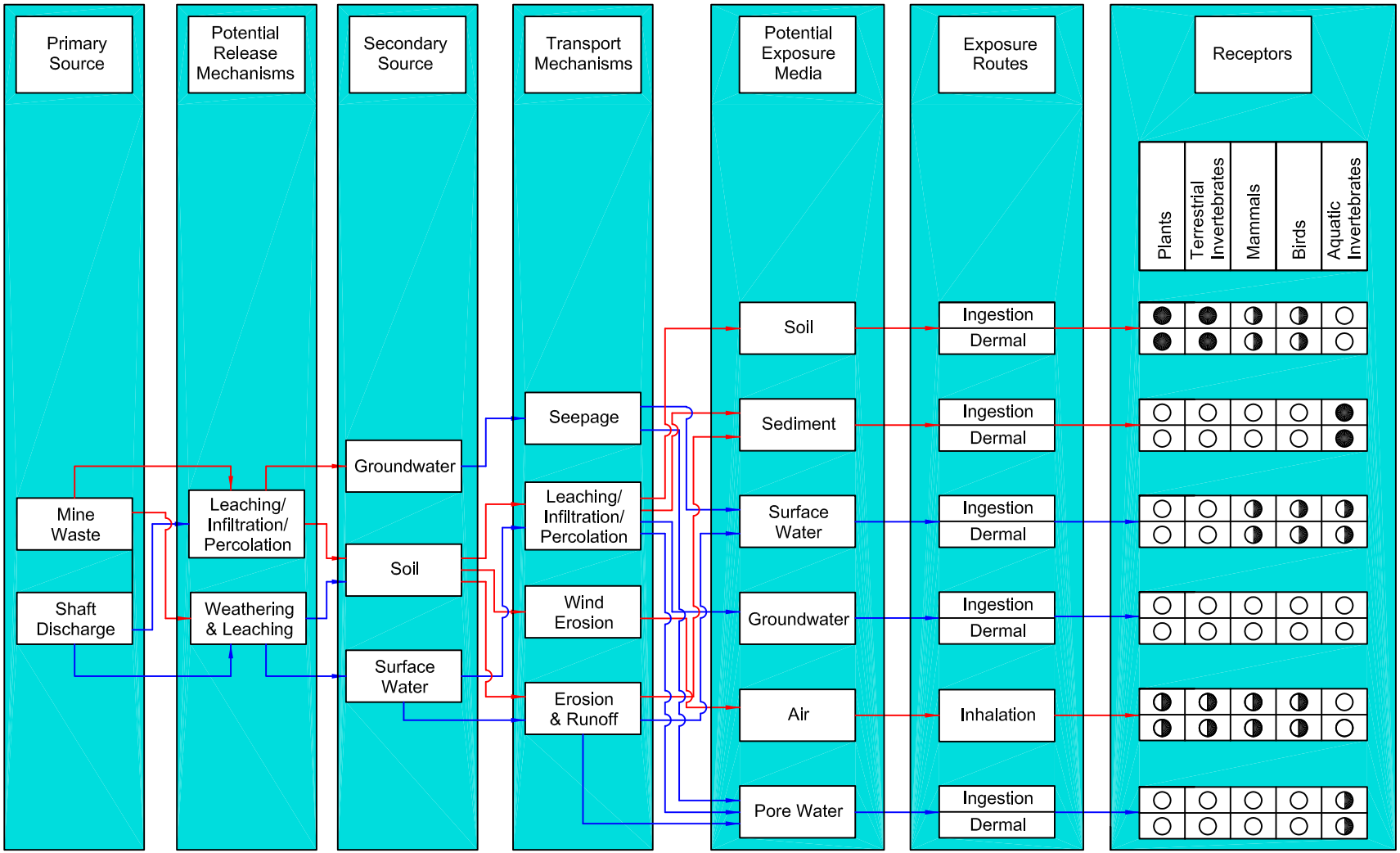
Legend

- ● Complete and potentially significant exposure pathway
- ◑ Potentially complete but insignificant exposure pathway
- ○ Incomplete exposure pathway

MSE Millenium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
Phone: (208) 345-8292

Human Health Conceptual Site Model

B2473D	12/22/08	HH CSM.dwg	FIGURE 1



Legend

- Complete and potentially significant exposure pathway
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Ecological Conceptual Site Exposure Model

B2473D	12/22/08	ERA CSM.dwg	FIGURE 2

TABLES

TABLE 1
Initial Risk Screening Using BLM Risk Management Criteria
Rabbit Mine Site Inspection

Media and Receptor	Units	Contaminant of Interest									
		Sb	As	Cd	Cu	Pb	Hg	Ni	Se	Ag	Zn
HUMAN HEALTH RISK SCREENING											
Background Soil MDC	mg/kg	**4.8**	**3.3**	**0.86**	**35.6**	**5.12**	**0.04**	**39.9**	***2.0***	***0.25***	**45.3**
Camper RMC	mg/kg	50	20	70	5,000	1,000	40	2,700	700	700	40,000
Mine Waste MDC	mg/kg	**14.2**	**1,280**	**2.8**	**118**	**194**	**2.63**	**79.9**	***2.0***	**0.71**	**270**
Camper RMC	mg/kg	50	20	70	5,000	1,000	40	2,700	700	700	40,000
Sediment MDC	mg/kg	***1.0***	**52.1**	**0.22**	**60.5**	**5.49**	**0.088**	**37.7**	***2.0***	***0.25***	**46.1**
Camper RMC	mg/kg	62	46	155	5,745	1,000	46	3,094	774	774	46,455
Surface Water MDC	mg/L	***0.0015***	**0.0039**	***0.0001***	**0.0012**	***0.0015***	***0.0001***	***0.0005***	***0.0015***	***0.00006***	***0.005***
Camper RMC	mg/L	0.1240	0.0930	0.1550	11.5	0.0500	0.0930	6.19	1.55	1.55	92.9
ECOLOGICAL RISK SCREENING											
Background Soil MDC	mg/kg	NC	**3.3**	**0.86**	**35.6**	**5.12**	**0.04**	NC	NC	NC	**45.3**
Deer Mouse RMC	mg/kg	NC	230	7	640	142	2	NC	NC	NC	419
Mule Deer RMC	mg/kg	NC	200	3	102	106	9	NC	NC	NC	222
Elk RMC	mg/kg	NC	328	3	131	127	11	NC	NC	NC	275
Robin RMC	mg/kg	NC	4	0.3	7	6	1	NC	NC	NC	43
Mine Waste MDC	mg/kg	NC	**1,280**	**2.8**	**118**	**194**	**2.63**	NC	NC	NC	**270**
Deer Mouse RMC	mg/kg	NC	230	7	640	142	2	NC	NC	NC	419
Mule Deer RMC	mg/kg	NC	200	3	102	106	9	NC	NC	NC	222
Elk RMC	mg/kg	NC	328	3	131	127	11	NC	NC	NC	275
Robin RMC	mg/kg	NC	4	0.3	7	6	1	NC	NC	NC	43

Notes:

< RMC = low risk

1 to 10X RMC = moderate risk

10 to 100X RMC = high risk

> 100X RMC = extremely high risk

BLM = U.S. Bureau of Land Management

NC = No RMC

MDC = Maximum detected concentration

RMC = Risk management criteria

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE 2
Human Health Contaminant of Potential Concern Summary
Rabbit Mine Site Inspection

Contaminant of Potential Concern	Media			
	Mine Waste	Surface Water	Sediment	Multimedia
Arsenic	X	X	X	X
Iron				X

TABLE 3
Human Health Exposure Point Concentration Summary
Rabbit Mine Site Inspection

COPC	Exposure Point Concentration					
	RME			CTE		
	Mine Waste (mg/kg)	Surface Water (mg/L)	Sediment (mg/kg)	Mine Waste (mg/kg)	Surface Water (mg/L)	Sediment (mg/kg)
Arsenic	396	0.004	51	204	0.002	25
Iron	58,597	0.048	33,900	58,597	0.048	33,900

Notes:
COPC = Contaminant of potential concern
CTE = Central tendency
RME = Reasonable maximum exposure
mg/kg = Milligram per kilogram
mg/L = Milligram per liter

TABLE 4
Human Health Exposure Factor Summary
Rabbit Mine Site Inspection

Medium	Exposure Route	Parameter Code	Parameter Definition	Units	Child Recreationalist			Adult Recreationalist			Adult Worker		
					RME Value	CTE Value	Reference	RME Value	CTE Value	Reference	RME Value	CTE Value	Reference
All	All	BW	Body Weight	kg	15	15	EPA 1997a	70	70	EPA 1997a	70	70	EPA 1997a
		AT-C	Averaging Time (Cancer)	day	25,550	25,550	EPA 1997a	25,550	25,550	EPA 1997a	25,550	25,550	EPA 1997a
		AT-N	Averaging Time (Non-Cancer)	day	2,190	2,190	365 x ED	10,950	3,285	365 x ED	9,125	2,190	365 x ED
		CF1	Conversion Factor	1 kg/mg	1.E-06	1.E-06		1.E-06	1.E-06		1.E-06	1.E-06	
		CF2	Conversion Factor	L/cm^3	1.E-03	1.E-03		1.E-03	1.E-03		1.E-03	1.E-03	
Mine Waste	Ingestion	IR-S	Incidental Ingestion Rate of Soil	mg/day	400	100	EPA 1997a	100	50	EPA 1997a	480	100	ODEQ 2000a
		EF	Exposure Frequency	day/year	2	1	(1)	7	4	(1)	14	7	(1)
		ED	Exposure Duration	years	6	6	(1)	30	9	(1)	25	6	(1)
	Dermal	SA	Skin Surface Area Available for Contact	cm^2	2800	2800	EPA 2004a	5700	5700	EPA 2004a	3300	3300	EPA 2004a
		DAF	Dermal Absorption Factor	--	CS	CS	EPA 2004a	CS	CS	EPA 2004a	CS	CS	EPA 2004a
		SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	1.0	0.30	EPA 2004a	0.08	0.08	EPA 2004a	1.0	0.30	ODEQ 2000a
	Inhalation	IN	Inhalation Rate	m^3/day	8	8	EPA 1997a	15	15	EPA 1997a	15	15	ODEQ 2000a
		PEF	Particulate Emission Factor	m^3/kg	1.3.E+09	1.3.E+09	EPA 2004a	1.3.E+09	1.3.E+09	EPA 2004a	1.3.E+09	1.3.E+09	EPA 2004a
Sediment	Ingestion	IR-S	Incidental Ingestion Rate of Sediment	mg/day	200	50	EPA 1997a	50	25	EPA 1997a	50	25	EPA 1997a
		EF	Exposure Frequency	day/year	2	1	(1)	7	4	(1)	14	7	(1)
		ED	Exposure Duration	years	6	6	(1)	30	9	(1)	25	6	(1)
	Dermal	SA	Skin Surface Area Available for Contact	cm^2	2,800	2,800	EPA 2004a	5,700	5,700	EPA 2004a	3,300	3,300	EPA 2004a
		DAF	Dermal Absorption Factor[a]	unitless	CS	CS	EPA 2004a	CS	CS	EPA 2004a	CS	CS	EPA 2004a
		SSAF	Soil to Skin Adherence Factor	mg/cm^2/day	1.0	0.04	EPA 2004a	0.07	0.01	EPA 2004a	1.0	0.04	EPA 2004a
Surface Water	Ingestion	IR-W	Ingestion Rate of Surface Water	L/day	0.02	0.01	EPA 1997a	0.01	0.01	EPA 1997a	0.01	0.01	EPA 1997a
		EF	Exposure Frequency	day/year	2	1	(1)	7	4	(1)	14	7	(1)
		ED	Exposure Duration	years	6	6	(1)	30	9	(1)	25	6	(1)
	Dermal	SA	Skin Surface Area Available for Contact	cm^2	2,800	2,800	EPA 2004a	5,700	5,700	EPA 2004a	3,300	3,300	EPA 2004a
		KP	Permeability Coefficient	cm/hr	CS	CS	EPA 2004a	CS	CS	EPA 2004a	CS	CS	EPA 2004a
		EVF	Event Frequency	event/day	1	1	Site specific	1	1	Site specific	1	1	Site specific
		ET	Exposure Time	hr/day	2	2	EPA 1997a	2	2	EPA 1997a	8	4	EPA 1997a

Notes:

(1) Site-specific assumed value

EPA 1997a *"Exposure Factors Handbook."* Volumes I through III. Office of Research and Development. EPA/600/P-95/002Fa, -Fb, -Fc. August.

EPA 2004a *"Risk Assessment Guidance for Superfund, Part E, Supplemental Guidance for Dermal Risk Assessment."* Volume I: Human Heath Evaluation Manual. Final. Office of Superfund Remediation and Technology Innovation. July.

ODEQ 2000a *"Guidance for Conduct of Deterministic Human Health Risk Assessments."* Final. Oregon Department of Environmental Quality (ODEQ). Updated May.

CTE = Central tendency exposure

RME = Reasonable maximum exposure

cm/hr = Centimeter per hour

cm^2 = Square centimeter

hr/day = Hour per day

kg/gm = Kilogram per milligram

L/day = Liter per day

L/cm^3 = Liter per cubic centimeter

mg/cm^2-day = Milligram per square centimeter per day

mg/day = Milligram per day

m^3/day = Cubic meter per day

m^3/kg = Cubic meter per kilogram

TABLE 5
Human Health Hazard and Cancer Risk Summary
Rabbit Mine Site Inspection

Media	Exposure Pathway	CENTRAL TENDENCY EXPOSURE						REASONABLE MAXIMUM EXPOSURE					
		ChildRecreationalist		Adult Recreationalist		Adult Worker		Child Recreationalist		Adult Recreationalist		Adult Worker	
		Non-carcinogenic HI	Carcinogenic ECR	Non-carcinogenic HI	Carcinogenic ECR	Non-carcinogenic HI	Carcinogenic ECR	Non-carcinogenic HI	Carcinogenic ECR	Non-carcinogenic HI	Carcinogenic ECR	Non-carcinogenic HI	Carcinogenic ECR
Mine Waste	Ingestion	0.02	5.E-07	0.01	3.E-07	0.02	7.E-07	0.2	**7.E-06**	0.04	**7.E-06**	0.4	**6.E-05**
	Dermal	0.01	3.E-07	0.004	2.E-07	0.01	5.E-07	0.1	**4.E-06**	0.01	**2.E-06**	0.2	**3.E-05**
	Inhalation	NA	3.E-10	NA	7.E-10	NA	7.E-10	NA	1.E-09	NA	8.E-09	NA	8.E-09
	Subtotal =	0.02	8.E-07	0.01	5.E-07	0.04	**1.E-06**	0.3	**1.E-05**	0.1	**9.E-06**	0.6	**8.E-05**
Sediment	Ingestion	0.002	3.E-08	0.001	2.E-08	0.001	2.E-08	0.02	5.E-07	0.004	5.E-07	0.01	8.E-07
	Dermal	0.0001	5.E-09	0.0001	3.E-09	0.0002	9.E-09	0.01	5.E-07	0.001	3.E-07	0.02	**4.E-06**
	Subtotal =	0.002	3.E-08	0.001	2.E-08	0.002	3.E-08	0.04	**1.E-06**	0.006	7.E-07	0.03	**4.E-06**
Surface Water	Ingestion	0.0000	5.E-10	0.0000	3.E-10	0.00001	4.E-10	0.0001	3.E-09	0.00004	7.E-09	0.0001	1.E-08
	Dermal	0.00002	7.E-10	0.00003	2.E-09	0.0001	2.E-09	0.0001	2.E-09	0.0001	2.E-08	0.0005	7.E-08
	Subtotal =	0.00003	1.E-09	0.00004	2.E-09	0.0001	3.E-09	0.0001	5.E-09	0.0001	3.E-08	0.0005	8.E-08
	TOTAL =	0.03	8.E-07	0.01	5.E-07	0.04	**1.E-06**	0.4	**1.E-05**	0.06	**1.E-05**	0.6	**9.E-05**

Notes:

ECR = Excess cancer risk

HI = Hazard index

NA = Not applicable

Bold values exceed risk screening levels.

TABLE 6
Human Health Risk-based Hot Spot Concentrations and Cleanup Levels
Rabbit Mine Site Inspection

Media	Contaminant	Risk-based Hot Spot Concentration[a] (mg/kg)	Risk-based Cleanup Level[b] (mg/kg)	Maximum Detected Concentration (mg/kg)	UCL_{90} Background Concentration (mg/kg)
Soil/Waste Rock	Arsenic	460	46	1,280	3
Sediment	Arsenic	1,160	116	52	NM

Notes:

[a]Based on a total cumulative excess cancer risk (ECR) of 1.E-04 for an adult worker under the reasonable maximum exposure (RME) scenario.

[b]Based on a total cumulative ECR of 1.E-05 for an adult worker under the RME scenario.

mg/kg = Milligram per kilogram

NM = Not measured

UCL_{90} = 90 percent upper confidence limit

TABLE 7
Mine Waste Contaminants of Potential Ecological Concern
Rabbit Mine Site Inspection

Analyte	Risk from Single COI				Risk from Multiple COIs			
	Plant	Invertebrate	Bird	Mammal	Plant	Invertebrate	Bird	Mammal
Antimony	Q<5	No SLV[a]	No SLV[a]	Q<5	--	--	--	--
Arsenic III	<5%	<5%	<5%	<5%	--	--	--	--
Arsenic V	No SLV[a]	No SLV[a]	No SLV[a]	No SLV[a]	--	--	--	--
Arsenic Total	No SLV[a]	No SLV[a]	No SLV[a]	No SLV[a]	--	--	--	--
Cadmium	**X**	Q<5	Q<5	Q<5	--	--	--	--
Chromium Total	No SLV[a]	No SLV[a]	No SLV[a]	No SLV[a]	--	--	--	--
Copper	Q<5	Q<5	Q<5	Q<5	--	--	--	--
Cyanide WAD	<5%	<5%	<5%	<5%	--	--	--	--
Cyanide Total	<5%	<5%	<5%	<5%	--	--	--	--
Iron	**X**	**X**	No SLV[a]	No SLV[a]	**X**	**X**	--	--
Lead	**X**	Q<5	**X**	Q<5	--	--	--	--
Mercury	**X**	**X**	Q<5	Q<5	--	--	--	--
Nickel	Q<5	Q<5	Q<5	Q<5	--	--	--	--
Selenium	<5%	<5%	<5%	<5%	--	--	--	--
Silver	Q<5	Q<5	No SLV[a]	No SLV[a]	--	--	--	--
Zinc	**X**	Q<5	Q<5	Q<5	--	--	--	--

Notes:
[a]Retained because of the lack of an SLV; may or may not present an ecological risk.
-- Not a multiple risk CPEC.
COI = Contaminant of interest
Q<5 = Screened out because risk ratio below screening level.
SLV = Screening level value
X = Retained as CPEC.
<5% = Screened out because not detected in more than 5% of the samples.

TABLE 8
Surface Water Contaminants of Potential Ecological Concern
Rabbit Mine Site Inspection

Analyte	Risk from Single COI			Risk from Multiple COIs		
	Aquatic Life	Bird	Mammal	Aquatic Life	Bird	Mammal
Antimony	<5%	<5%	<5%	--	--	--
Arsenic III	<5%	<5%	<5%	--	--	--
Arsenic V	Q<5	No SLV[a]	No SLV[a]	--	--	--
Arsenic	No SLV[a]	No SLV[a]	No SLV[a]	--	--	--
Cadmium	<5%	<5%	<5%	--	--	--
Calcium	Essential	Essential	Essential	--	--	--
Chromium Total	<5%	<5%	<5%	--	--	--
Copper	Q<5	No SLV[a]	Q<5	--	--	--
Cyanide WAD	<5%	<5%	<5%	--	--	--
Cyanide Total	<5%	<5%	<5%	--	--	--
Iron	Essential	Essential	Essential	--	--	--
Lead	<5%	<5%	<5%	--	--	--
Magnesium	Essential	Essential	Essential	--	--	--
Mercury	<5%	<5%	<5%	--	--	--
Nickel	<5%	<5%	<5%	--	--	--
Selenium	<5%	<5%	<5%	--	--	--
Silver	<5%	<5%	<5%	--	--	--
Zinc	<5%	<5%	<5%	--	--	--

Notes:
[a]Retained because of the lack of an SLV; may or may not present an ecological risk.
-- Not a multiple risk CPEC.
COI = Contaminant of interest
CPEC = Contaminant of potential ecological concern
Essential = Screened out because essential nutrient.
Q<5 = Screened out because risk ratio below screening level.
SLV = Screening level value
<5% = Screened out because not detected in more than 5% of the samples.

TABLE 9
Sediment Contaminants of Potential Ecological Concern
Rabbit Mine Site Inspection

Analyte	Freshwater Sediment Risk	Bioaccumulation Risk
Antimony	<5%	<5%
Arsenic III	<5%	<5%
Arsenic V	<5%	<5%
Arsenic Total	No SLV[a]	No SLV[a]
Cadmium	Q<5	**X**
Chromium Total	Q<5	Q<5
Copper	Q<5	**X**
Cyanide WAD	<5%	<5%
Cyanide Total	<5%	<5%
Iron	Essential	Essential
Lead	Q<5	Q<5
Mercury	Q<5	No SLV[a]
Nickel	Q<5	Q<5
Selenium	<5%	<5%
Silver	<5%	<5%
Zinc	Q<5	**X**

Notes:

[a]Retained because of the lack of an SLV; may or may not present an ecological risk.

Q<5 = Screened out because risk ratio below screening level.

SLV = Screening level value

X = Retained as CPEC.

<5% = Screened out because not detected in more than 5% of the samples.

Essential = Screened out because essential nutrient.

TABLE 10
Pore Water Contaminants of Potential Ecological Concern
Rabbit Mine Site Inspection

Analyte	Aquatic Life	
	Risk from Single COI	Risk from Multiple COIs
Antimony	<5%	--
Arsenic Total	No SLV[a]	--
Cadmium	<5%	--
Calcium	Essential	--
Chromium	<5%	--
Copper	<5%	--
Cyanide WAD	<5%	--
Cyanide Total	<5%	--
Iron	Essential	--
Magnesium	Essential	--
Mercury	<5%	--
Selenium	<5%	--
Silver	<5%	--
Zinc	<5%	--

Notes:
[a]Retained because of the lack of an SLV; may or may not present an ecological risk.
-- Not a multiple risk CPEC.
COI = Contaminant of interest
SLV = Screening level value
<5% = Screened out because not detected in more than 5% of the samples.
Essential = Screened out because essential nutrient.

TABLE 11
Contaminants of Potential Ecological Concern Summary
Rabbit Mine Site Inspection

CPEC	Media			
	Mine Waste	**Surface Water**	**Sediment**	**Pore Water**
Antimony	No SLV[a]	--	--	--
Arsenic V	No SLV[a]	No SLV[a]	--	NA
Arsenic Total	No SLV[a]	No SLV[a]	No SLV[a]	No SLV[a]
Cadmium	**P**	--	**Bio**	--
Chromium Total	No SLV[a]	--	--	--
Copper	**--**	No SLV[a]	**Bio**	--
Iron	**P,I**	--	--	--
Mercury	**P,I**	--	No SLV[a]	--
Silver	No SLV[a]	--	--	--
Zinc	**P**	--	**Bio**	--

Notes:
[a]Retained because of the lack of an SLV; may or may not present an ecological risk.
-- Screened out
Bio = Bioaccumulation risk
CPEC = Contaminant of potential ecological concern
I = Invertebrate
NA = Not analyzed for
P = Plant
SLV = Screening level value

TABLE 12
Ecological Risk Ratio Summary
Rabbit Mine Site Inspection

CPEC	Mine Waste				Surface Water			Sediment		Pore Water
	Plant	Invertebrate	Bird	Mammal	Bird	Mammal	Aquatic Life	Freshwater	Bio-accumulation	Aquatic Life
Antimony	<5	NS	NS	<5	--	--	--	--	--	--
Arsenic V	NS	NS	NS	NS	NS	NS	<5	--	--	--
Arsenic Total	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cadmium	<5	<5	<5	<5	--	--	--	<5	**73**	--
Chromium Total	NS	NS	NS	NS	--	--	--	<5	<5	--
Copper	<5	<5	<5	<5	NS	<5	<5	<5	**6**	--
Iron	**8,610**	**431**	NS	NS	--	--	--	--	--	--
Mercury	**9**	**26**	<5	<5	--	--	--	<5	NS	--
Silver	<5	<5	NS	NS	--	--	--	--	--	--
Zinc	**5.4**	<5	<5	<5	--	--	--	<5	**15**	--

Notes:
Bold values exceed the risk screening ratio for non-protected species (Q = 5).
CPEC = Contaminant of potential ecological concern
NS = No screening level value
-- Not calculated because not a CPEC for this media.

ATTACHMENT A

HUMAN HEALTH RISK CALCULATION TABLES

TABLE A.1
Human Health Exposure Pathways and Receptors
Rabbit Mine

Scenario Timeframe	Exposure Media	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-site/ Off-site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil	Mine Waste	Recreationalist	Adult Child	Ingestion Dermal Inhalation	On-Site	Quantitative	Current (Baseline)
			Worker	Adult				
	Sediment	Stream and Pond	Recreationalist	Adult Child	Ingestion Dermal	On-Site	Quantitative	Current (Baseline)
			Worker	Adult				
	Surface Water	Stream and Pond	Recreationalist	Adult Child	Ingestion Dermal	On-Site	Quantitative	Current (Baseline)
			Worker	Adult				

TABLE A.2
Human Health Contaminant of Potential Concern Screening
Rabbit Mine

		Mine Waste Screening											Surface Water Screening											Sediment Screening											Multimedia	
Metal	**Essential Nutrient?**	**Detect Freq**	**Detect Freq > 5% Retain as COPC?**	**MDC (C_{ij})**	**UCL_{90} BG Conc**	**MDC>BG Retain as COPC?**	**Soil Screening Criteria[b] (PRG_{ij})**	**Units**	**R_{ij} (C_{ij}/PRG_j)**	**MDC>PRG Retain as COPC?**	**R_{ij}/R_j**	**Multi COI Retain as COPC?**	**Detect Freq**	**Freq > 5% Retain as**	**MDC (C_{ij})**	**Avg BG Conc**	**MDC>BG Retain as COPC?**	**Water Screening Criteria[c] (PRG_{ij})**	**Units**	**R_{ij} (C_{ij}/PRG_j)**	**MDC>PRG Retain as COPC?**	**R_{ij}/R_j**	**COI Retain as COPC?**	**Detect Freq**	**Freq > 5% Retain as**	**MDC (C_{ij})**	**MDC BG Conc**	**MDC>BG Retain as COPC?**	**Soil Screening Criteria[b] (PRG_{ij})**	**Units**	**R_{ij} (C_{ij}/PRG_j)**	**MDC>PRG Retain as COPC?**	**R_{ij}/R_j**	**COI Retain as COPC?**	**Sum R_{ij}**	**Multi media Retain as COPC?**
Antimony	No	100%	**Yes**	14.2	4.2	**Yes**	410	mg/kg	3.46E-02	No	4.32E-05	No	0%	No	*0.0015*	*0.0015*	No	0.006	mg/L	2.68E-01	No	1.53E-04	No	0%	No	*1.0*	NM	**Yes**	4.1E+02	mg/kg	2.44E-03	No	7.36E-05	No	3.05E-01	No
$Arsenic_{Tot}$	No	100%	**Yes**	1280	3.4	**Yes**	1.6	mg/kg	8.00E+02	**Yes**	9.98E-01	**Yes**	25%	**Yes**	0.00385	*0.0015*	**Yes**	0.0000022	mg/L	1.75E+03	**Yes**	9.99E-01	**Yes**	100%	**Yes**	52.1	NM	**Yes**	1.6E+00	mg/kg	3.26E+01	**Yes**	9.83E-01	**Yes**	2.58E+03	**Yes**
Cadmium	No	47%	**Yes**	2.76	0.9	**Yes**	450	mg/kg	6.13E-03	No	7.65E-06	No	0%	No	*0.0001*	*0.0001*	No	NS			No		No	33%	**Yes**	0.22	NM	**Yes**	4.5E+02	mg/kg	4.89E-04	No	1.48E-05	No	6.62E-03	No
$Chromium_{tot}$	No	100%	**Yes**	141	42.4	**Yes**	450	mg/kg	3.13E-01	No	3.91E-04	No	0%	No	*0.00125*	*0.0013*	No	NS			No		No	100%	**Yes**	57.5	NM	**Yes**	4.5E+02	mg/kg	1.28E-01	No	3.86E-03	No	4.41E-01	No
Copper	No	100%	**Yes**	118	35	**Yes**	41,000	mg/kg	2.87E-03	No	3.58E-06	No	25%	**Yes**	0.00123	*0.0005*	**Yes**	1.3	mg/L	9.46E-04	No	5.40E-07	No	100%	**Yes**	60.5	NM	**Yes**	4.1E+04	mg/kg	1.48E-03	No	4.45E-05	No	5.29E-03	No
Iron	**Yes**	100%	**Yes**	86100	34300	**Yes**	100000	mg/kg	8.61E-01	No	1.07E-03	No	25%	**Yes**	0.101	*0.03*	**Yes**	0.3	mg/L	3.37E-01	No	1.92E-04	No	100%	**Yes**	42800	NM	**Yes**	1.0E+05	mg/kg	4.28E-01	No	1.29E-02	No	1.63E+00	**Yes**
Lead	No	100%	**Yes**	194	4.9	**Yes**	800	mg/kg	2.43E-01	No	3.03E-04	No	0%	No	*0.0015*	*0.0015*	No	NS			No		No	100%	**Yes**	5.49	NM	**Yes**	8.0E+02	mg/kg	6.86E-03	No	2.07E-04	No	2.49E-01	No
Mercury	No	93%	**Yes**	2.63	0.04	**Yes**	310	mg/kg	8.48E-03	No	1.06E-05	No	0%	No	*0.0001*	*0.0001*	No	0.00014	mg/L	6.94E-01	No	3.97E-04	No	100%	**Yes**	0.088	NM	**Yes**	3.1E+02	mg/kg	2.84E-04	No	8.57E-06	No	7.03E-01	No
Nickel	No	1.0000	**Yes**	79.9	33.8	**Yes**	20000	mg/kg	4.00E-03	No	4.98E-06	No	0%	No	*0.0005*	*0.0005*	No	0.61	mg/L	8.20E-04	No	4.68E-07	No	100%	**Yes**	37.7	NM	**Yes**	2.0E+04	mg/kg	1.89E-03	No	5.69E-05	No	6.70E-03	No
Selenium	No	0%	No	*2.0*	*2.0*	No	5100	mg/kg	3.92E-04	No	4.89E-07	No	0%	No	*0.0015*	*0.0015*	No	0.17	mg/L	8.82E-03	No	5.04E-06	No	0%	No	*2.0*	NM	**Yes**	5.1E+03	mg/kg	3.92E-04	No	1.18E-05	No	9.61E-03	No
Silver	No	7%	**Yes**	0.71	*0.25*	**Yes**	5100	mg/kg	1.39E-04	No	1.74E-07	No	0%	No	*0.00006*	*0.00006*	No	0.05	mg/L	1.25E-03	No	7.14E-07	No	0%	No	*0.25*	NM	**Yes**	5.1E+03	mg/kg	4.90E-05	No	1.48E-06	No	1.44E-03	No
Zinc	No	100%	**Yes**	270	45	**Yes**	100000	mg/kg	2.70E-03	No	3.37E-06	No	0%	No	*0.005*	*0.005*	No	7.4	mg/L	6.76E-04	No	3.86E-07	No	100%	**Yes**	46.1	NM	**Yes**	1.0E+05	mg/kg	4.61E-04	No	1.39E-05	No	3.84E-03	No
Cyanide	No	0%	No	*0.25*	*0.25*	No	1200	mg/kg	2.08E-04	No	2.60E-07	No	0%	No	*0.005*	*0.005*	No	0.14	mg/L	3.57E-02	No	2.04E-05	No	0%	No	*0.25*	NM	**Yes**	1.2E+03	mg/kg	2.08E-04	No	6.29E-06	No	3.61E-02	No
		R_j =	801										**R_j =**	1751										**R_j =**	33											
		N_{ij} =	13										**N_{ij} =**	10										**N_{ij} =**	13											
		$1/N_{ij}$ =	0.08										**$1/N_{ij}$ =**	0.10										**$1/N_{ij}$ =**	0.077											

Notes:

Italics - result below reporting limit (RL); value = 1/2 RL.

[a]Lower of EPA Region 9 Industrial Soil PRGs (EPA 2004b) and Oregon Industrial Maximum Allowable Soil Concentration Cleanup Levels (ODEQ 2000b).

[b]Essential nutrient

[c]Lower of EPA recommended chronic ambient water quality criteria for human consumption of water and fish (EPA 2006), and Oregon human health water quality criteria for consumption of water and fish (ODEQ 2005).

[d]Secondary contaminant that is generally limited to cosmetic or aesthetic effects, such as taste, odor, color, skin discoloration.

BG = Background
COI = Contaminant of interest
Conc = Concentration
COPC = Contaminant of potential concern
EPA = U.S. Environmental Protection Agency
MDC = Maximum detected concentration
NA = Not analyzed
NM = Not measured
NS = No screening criteria
PRG = Preliminary remediation goal
mg/kg = Milligram per kilogram
mg/L = Milligram per liter

TABLE A.3
Exposure Factors
Rabbit Mine

Medium	Exposure Route	Parameter Code	Parameter Definition	Units	Child Recreationalist			Adult Recreationalist			Adult Worker		
					RME Value	CTE Value	Reference	RME Value	CTE Value	Reference	RME Value	CTE Value	Reference
All	All	BW	Body Weight	kg	15	15	EPA 1997a	70	70	EPA 1997a	70	70	EPA 1997a
		AT-C	Averaging Time (Cancer)	day	25,550	25,550	EPA 1997a	25,550	25,550	EPA 1997a	25,550	25,550	EPA 1997a
		AT-N	Averaging Time (Non-Cancer)	day	2,190	2,190	365 x ED	10,950	3,285	365 x ED	9,125	2,190	365 x ED
		CF1	Conversion Factor	1 kg/mg	1E-06	1E-06		1E-06	1E-06		1E-06	1E-06	
		CF2	Conversion Factor	L/cm^3	1E-03	1E-03		1E-03	1E-03		1E-03	1E-03	
Mine Waste	Ingestion	IR-S	Incidental Ingestion Rate of Soil	mg/day	400	100	EPA 1997a	100	50	EPA 1997a	480	100	ODEQ 2000a
		EF	Exposure Frequency	day/year	2	1	(1)	7	4	(1)	14	7	(1)
		ED	Exposure Duration	years	6	6	(1)	30	9	(1)	25	6	(1)
	Dermal	SA	Skin Surface Area Available for Contact	cm^2	2800	2800	EPA 2004a	5700	5700	EPA 2004a	3300	3300	EPA 2004a
		DAF	Dermal Absorption Factor	--	CS	CS	EPA 2004a	CS	CS	EPA 2004a	CS	CS	EPA 2004a
		SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	1.0	0.3	EPA 2004a	0.08	0.08	EPA 2004a	1.0	0.3	ODEQ 2000a
	Inhalation	IN	Inhalation Rate	m^3/day	8.3	8.3	EPA 1997a	15.2	15.2	EPA 1997a	15.2	15.2	ODEQ 2000a
		PEF	Particulate Emission Factor	m^3/kg	1.31E+09	1.31E+09	EPA 2004a	1.31E+09	1.31E+09	EPA 2004a	1.31E+09	1.31E+09	EPA 2004a
Sediment	Ingestion	IR-S	Incidental Ingestion Rate of Sediment	mg/day	200	50	EPA 1997a	50	25	EPA 1997a	50	25	EPA 1997a
		EF	Exposure Frequency	day/year	2	1	(1)	7	4	(1)	14	7	(1)
		ED	Exposure Duration	years	6	6	(1)	30	9	(1)	25	6	(1)
	Dermal	SA	Skin Surface Area Available for Contact	cm^2	2,800	2,800	EPA 2004a	5,700	5,700	EPA 2004a	3,300	3,300	EPA 2004a
		DAF	Dermal Absorption Factor[a]	unitless	CS	CS	EPA 2004a	CS	CS	EPA 2004a	CS	CS	EPA 2004a
		SSAF	Soil to Skin Adherence Factor	mg/cm^2/day	1.0	0.04	EPA 2004a	0.07	0.01	EPA 2004a	1.0	0.04	EPA 2004a
Surface Water	Ingestion	IR-W	Ingestion Rate of Surface Water	L/day	0.015	0.01	EPA 1997a	0.01	0.005	EPA 1997a	0.01	0.005	EPA 1997a
		EF	Exposure Frequency	day/year	2	1	(1)	7	4	(1)	14	7	(1)
		ED	Exposure Duration	years	6	6	(1)	30	9	(1)	25	6	(1)
	Dermal	SA	Skin Surface Area Available for Contact	cm^2	2,800	2,800	EPA 2004a	5,700	5,700	EPA 2004a	3,300	3,300	EPA 2004a
		KP	Permeability Coefficient	cm/hr	CS	CS	EPA 2004a	CS	CS	EPA 2004a	CS	CS	EPA 2004a
		EVF	Event Frequency	event/day	1	1	Site specific	1	1	Site specific	1	1	Site specific
		ET	Exposure Time	hr/day	2	2	EPA 1997a	2	2	EPA 1997a	8	4	EPA 1997a

Notes:

(1) Site-specific assumed value

EPA 1997a *"Exposure Factors Handbook."* Volumes I through III. Office of Research and Development. EPA/600/P-95/002Fa, -Fb, -Fc. August.

EPA 2004a *"Risk Assessment Guidance for Superfund, Part E, Supplemental Guidance for Dermal Risk Assessment."* Volume I: Human Heath Evaluation Manual. Final. Office of Superfund Remediation and Technology Innovation. July.

ODEQ 2000a *"Guidance for Conduct of Deterministic Human Health Risk Assessments."* Final. Oregon Department of Environmental Quality (ODEQ). Updated May.

CTE = Central tendency exposure

RME = Reasonable maximum exposure

cm/hr = Centimeter per hour

cm^2 = Square centimeter

hr/day = Hour per day

kg/gm = Kilogram per milligram

L/day = Liter per day

L/cm^3 = Liter per cubic centimeter

mg/cm^2-day = Milligram per square centimeter per day

mg/day = Milligram per day

m^3/day = Cubic meter per day

m^3/kg = Cubic meter per kilogram

TABLE A.4
Exposure Point Concentrations
Rabbit Mine

Contaminant of Potential Concern	Media	Arithmetic Mean	90% UCL	Maximum Detected Concentration	Units	REASONABLE MAXIMUM EXPOSURE			CENTRAL TENDENCY EXPOSURE		
						Media EPC Value	Media EPC Statistic	Media EPC Rationale	Media EPC Value	Media EPC Statistic	Media EPC Rationale
Arsenic	Mine Waste	204	396	1,280	mg/kg	396	90% UCL	RAGS	204	Mean	RAGS
	Surface Water	0.002	0.00385	0.00385	mg/L	0.00385	MDC	90% UCL > MDC	0.0021	Mean	RAGS
	Sediment	25.5	51.2	52.1	mg/kg	51.2	MDC	90% UCL > MDC	25.5	Mean	RAGS
Iron	Mine Waste	58,597	61,000	86,100	mg/kg	61,000	90% UCL	RAGS	58,597	Mean	RAGS
	Surface Water	0.048	0.101	0.101	mg/L	0.101	MDC	90% UCL > MDC	0.05	Mean	RAGS
	Sediment	33,900	42,800	42,800	mg/kg	42,800	MDC	90% UCL > MDC	33,900	Mean	RAGS

Notes:

EPC = Exposure point concentration

MDC = Maximum detected concentration

NM = Not measured

RAGS = U.S. Environmental Protection Agency (EPA), 1991. *"Risk Assessment Guidance for Superfund (RAGS): Volume 1, Human Health Evaluation Manual"* (Part A), No. 9285.701A. Office of Solid Waste and Emergency Response, Washington, DC.

UCL = Upper confidence limit

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE A.5
Non-carcinogenic COPC Toxicity Values
Rabbit Mine

Contaminant of Potential Concern	CAS Number	Chronic RfD (mg/kg-d)			Dermal Absorption Factor	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Data Source
		Oral	Dermal	Inhalation				
Arsenic	7440382	3.00E-04	1.23E-04	NA	0.03	Skin, Nervous System, Cardiovascular System	1000/1	IRIS/RAIS
Iron	7439896	3.00E-01	NA	NA	0	Liver, Kidneys	--/--	RAIS

Notes:
COPC = Contaminant of potential concern
IRIS = Integrated Risk Information System
NA = Not available
RAIS = Risk Assessment Information System
RfD = Reference dose
mg/kg-d = Milligram per kilogram per day

TABLE A.6
Carcinogenic COPC Toxicity Values
Rabbit Mine

Contaminant of Potential Concern	CAS Number	Slope Factor $(mg/kg\text{-}day)^{-1}$			Type of Cancer	Weight of Evidence/Cancer Guideline Description	Data Source
		Oral	Dermal	Inhalation			
Arsenic	7440382	1.50E+00	3.66E+00	1.51E+01	Skin, lung	A	IRIS

Notes:
A = Known human carcinogen
IRIS = Integrated Risk Information System
mg/kg-day = Milligram per kilogram per day

TABLE A.7a
Non-carcinogenic Hazards - Child Recreationalist
Rabbit Mine

					CENTRAL TENDENCY EXPOSURE SCENARIO								REASONABLE MAXIMUM EXPOSURE SCENARIO							
		Chronic Reference Dose (mg/kg-day)			CTE EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Non-carcinogenic Hazard by Exposure Route			CTE Total Hazard	RME EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Non-carcinogenic Hazard by Exposure Route			RME Total Hazard
Media	COPC	Oral	Dermal	Inhalation		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation			Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation	
Mine Waste	As	3.0E-04	1.2E-04	NA	204	4E-06	9E-07	2E-10	0.01	0.01	NA	0.02	396	6E-05	1E-05	9E-10	0.2	0.1	NA	0.3
	Fe	3.0E-01	NA	NA	58,597	1E-03	9E-06	7E-08	0.004	NA	NA	0.004	61000	9E-03	6E-05	1E-07	0.03	NA	NA	0.03
								Mine Waste CTE Subtotal =	**0.02**	**0.01**	**NA**	**0.02**				**Mine Waste RME Subtotal =**	**0.2**	**0.1**	**NA**	**0.3**
Sediment	As	3.0E-04	1.2E-04	NA	25.5	2E-07	2E-08	NA	0.001	0.0001	NA	0.001	51	4E-06	2E-06	NA	0.01	0.01	NA	0.03
	Fe	3.0E-01	NA	NA	33900	3E-04	7E-07	NA	0.001	NA	NA	0.001	42800	3E-03	4E-05	NA	0.01	NA	NA	0.01
								Sediment CTE Subtotal =	**0.002**	**0.0001**	**NA**	**0.002**				**Sediment RME Subtotal =**	**0.02**	**0.01**	**NA**	**0.04**
Surface Water	As	3.0E-04	1.2E-04	NA	0.002	4E-09	2E-09	NA	0.00001	0.00002	NA	0.00003	0.004	2E-08	8E-09	NA	0.0001	0.0001	NA	0.0001
	Fe	3.0E-01	NA	NA	0.05	9E-08	5E-08	NA	0.0000003	NA	NA	0.0000003	0.1	6E-07	2E-07	NA	0.000002	NA	NA	0.000002
								Surface Water CTE Subtotal =	**0.00001**	**0.00002**	**NA**	**0.00003**				**Surface Water RME Subtotal =**	**0.0001**	**0.0001**	**NA**	**0.0001**
								Total CTE Non-carcinogenic Hazard =	**0.02**	**0.01**	**NA**	**0.03**				**Total RME Non-carcinogenic Hazard =**	**0.2**	**0.1**	**NA**	**0.4**

Notes:

COPC = Contaminant of potential concern

CTE = Central tendency exposure

EPC = Exposure point concentration

NA = Not applicable

RME = Reasonable maximum exposure

mg/kg-day = Milligram per kilogram per day

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE A.7b
Non-carcinogenic Hazards - Adult Recreationalist
Rabbit Mine

Media	COPC	Chronic Reference Dose (mg/kg-day)			CENTRAL TENDENCY EXPOSURE SCENARIO								REASONABLE MAXIMUM EXPOSURE SCENARIO							
					CTE EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Non-carcinogenic Hazard by Exposure Route			CTE Total Hazard	RME EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Non-carcinogenic Hazard by Exposure Route			RME Total Hazard
		Oral	Dermal	Inhalation		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation			Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation	
Mine Waste	As	3.0E-04	1.2E-04	NA	204	2E-06	4E-07	4E-10	0.01	0.004	NA	0.01	396	1E-05	1E-06	1E-09	**0.04**	0.01	NA	0.05
	Fe	3.0E-01	NA	NA	58,597	5E-04	4E-06	1E-07	0.002	NA	NA	0.002	61000	2E-03	8E-06	2E-07	0.01	NA	NA	0.01
								Mine Waste CTE Subtotal =	**0.01**	**0.004**	**NA**	**0.01**				**Mine Waste RME Subtotal =**	**0.04**	**0.01**	**NA**	**0.1**
Sediment	As	3.0E-04	1.2E-04	NA	25.5	1E-07	7E-09	NA	0.0003	0.0001	NA	0.0004	51.2	7E-07	2E-07	NA	0.002	0.001	NA	0.004
	Fe	3.0E-01	NA	NA	33900	1E-04	3E-07	NA	0.0004	NA	NA	0.0004	42800	6E-04	5E-06	NA	0.002	NA	NA	0.002
								Sediment CTE Subtotal =	**0.001**	**0.0001**	**NA**	**0.001**				**Sediment RME Subtotal =**	**0.004**	**0.001**	**NA**	**0.01**
Surface Water	As	3.0E-04	1.2E-04	NA	0.0021	2E-09	4E-09	NA	0.00001	0.00003	NA	0.00004	0.004	1E-08	1E-08	NA	0.00004	0.0001	NA	0.0001
	Fe	3.0E-01	NA	NA	0.05	4E-08	9E-08	NA	0.0000001	NA	NA	0.0000001	0.10	3E-07	3E-07	NA	0.000001	NA	NA	0.000001
								Surface Water CTE Subtotal =	**0.00001**	**0.00003**	**NA**	**0.00004**				**Surface Water RME Subtotal =**	**0.00004**	**0.0001**	**NA**	**0.0001**
								Total CTE Non-carcinogenic Hazard =	**0.01**	**0.004**	**NA**	**0.01**				**Total RME Non-carcinogenic Hazard =**	**0.05**	**0.01**	**NA**	**0.1**

Notes:

COPC = Contaminant of potential concern

CTE = Central tendency exposure

EPC = Exposure point concentration

NA = Not applicable

RME = Reasonable maximum exposure

mg/kg-day = Milligram per kilogram per day

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE A.7c
Non-carcinogenic Hazards - Adult Worker
Rabbit Mine

					CENTRAL TENDENCY EXPOSURE SCENARIO								REASONABLE MAXIMUM EXPOSURE SCENARIO							
		Chronic Reference Dose (mg/kg-day)			CTE EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Non-carcinogenic Hazard by Exposure Route			CTE Total Hazard	RME EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Non-carcinogenic Hazard by Exposure Route			RME Total Hazard
Media	COPC	Oral	Dermal	Inhalation		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation			Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation	
Mine Waste	As	3.0E-04	1.2E-04	NA	204	6E-06	2E-06	4E-10	0.02	0.01	NA	0.03	396	1E-04	2E-05	1E-09	0.3	0.2	NA	0.5
	Fe	3.0E-01	NA	NA	58,597	2E-03	2E-05	1E-07	0.01	NA	NA	0.01	61000	2E-02	1E-04	2E-07	0.1	NA	NA	0.1
								Mine Waste CTE Subtotal =	**0.02**	**0.01**	**NA**	**0.04**				**Mine Waste RME Subtotal =**	**0.4**	**0.2**	**NA**	**0.6**
Sediment	As	3.0E-04	1.2E-04	NA	25.5	2E-07	3E-08	NA	0.001	0.0002	NA	0.001	51	1E-06	3E-06	NA	0.005	0.02	NA	0.03
	Fe	3.0E-01	NA	NA	33900	2E-04	1E-06	NA	0.001	NA	NA	0.001	42800	1E-03	8E-05	NA	0.004	NA	NA	0.004
								Sediment CTE Subtotal =	**0.001**	**0.0002**	**NA**	**0.002**				**Sediment RME Subtotal =**	**0.01**	**0.02**	**NA**	**0.03**
Surface Water	As	3.0E-04	1.2E-04	NA	0.002	3E-09	8E-09	NA	0.00001	0.0001	NA	0.0001	0.004	2E-08	6E-08	NA	0.0001	0.0005	NA	0.001
	Fe	3.0E-01	NA	NA	0.05	7E-08	2E-07	NA	0.0000002	NA	NA	0.0000002	0.10	6E-07	1E-06	NA	0.000002	NA	NA	0.000002
								Surface Water CTE Subtotal =	**0.00001**	**0.0001**	**NA**	**0.0001**				**Surface Water RME Subtotal =**	**0.0001**	**0.0005**	**NA**	**0.001**
								Total CTE Non-carcinogenic Hazard =	**0.03**	**0.01**	**NA**	**0.04**				**Total RME Non-carcinogenic Hazard =**	**0.4**	**0.2**	**NA**	**0.6**

Notes:

COPC = Contaminant of potential concern

CTE = Central tendency exposure

EPC = Exposure point concentration

NA = Not applicable

RME = Reasonable maximum exposure

mg/kg-day = Milligram per kilogram per day

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE A.8a
Carcinogenic Risks - Child Recreationalist
Rabbit Mine

					CENTRAL TENDENCY EXPOSURE SCENARIO								REASONABLE MAXIMUM EXPOSURE SCENARIO							
		Cancer Slope Factor (mg/kg-day)$^{-1}$			CTE EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Carcinogenic Risk by Exposure Route			CTE Total Risk	RME EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Carcinogenic Risk by Exposure Route			RME Total Risk
Media	COPC	Oral	Dermal	Inhalation		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation			Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation	
Mine Waste	As	1.5E+00	3.7E+00	1.5E+01	204	3E-07	8E-08	2E-11	5E-07	3E-07	3E-10	8E-07	396	5E-06	1E-06	8E-11	**7E-06**	**4E-06**	1E-09	**1E-05**
								Mine Waste CTE Subtotal =	**5E-07**	**3E-07**	**3E-10**	**8E-07**				**Mine Waste RME Subtotal =**	**7E-06**	**4E-06**	**1E-09**	**1E-05**
Sediment	As	1.5E+00	3.7E+00	NA	25.5	2E-08	1E-09	NA	3E-08	5E-09	NA	3E-08	51.2	3E-07	1E-07	NA	5E-07	5E-07	NA	**1E-06**
								Sediment CTE Subtotal =	**3E-08**	**5E-09**	**NA**	**3E-08**				**Sediment RME Subtotal =**	**5E-07**	**5E-07**	**NA**	**1E-06**
Surface Water	As	1.5E+00	3.7E+00	NA	0.002	3E-10	2E-10	NA	5E-10	7E-10	NA	1E-09	0.004	2E-09	7E-10	NA	3E-09	2E-09	NA	5E-09
								Surface Water CTE Subtotal =	**5E-10**	**7E-10**	**NA**	**1E-09**				**Surface Water RME Subtotal =**	**3E-09**	**2E-09**	**NA**	**5E-09**
								Total CTE Carcinogenic Risk =	**5E-07**	**3E-07**	**3E-10**	**8E-07**				**Total RME Carcinogenic Risk =**	**8E-06**	**4E-06**	**1E-09**	**1E-05**

Notes:

COPC = Contaminant of potential concern

CTE = Central tendency exposure

EPC = Exposure point concentration

NA = Not applicable

RME = Reasonable maximum exposure

mg/kg-day = Milligram per kilogram per day

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE A.8b
Carcinogenic Risks - Adult Recreationalist
Rabbit Mine

					CENTRAL TENDENCY EXPOSURE SCENARIO								REASONABLE MAXIMUM EXPOSURE SCENARIO							
		Cancer Slope Factor (mg/kg-day)$^{-1}$			CTE EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Carcinogenic Risk by Exposure Route			CTE Total Risk	RME EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Carcinogenic Risk by Exposure Route			RME Total Risk
Media	COPC	Oral	Dermal	Inhalation		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation			Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation	
Mine Waste	As	1.5E+00	3.7E+00	1.5E+01	204	2E-07	6E-08	5E-11	3E-07	2E-07	7E-10	5E-07	396	5E-06	6E-07	5E-10	**7E-06**	**2E-06**	8E-09	**9E-06**
								Mine Waste CTE Subtotal =	**3E-07**	**2E-07**	**7E-10**	**5E-07**				**Mine Waste RME Subtotal =**	**7E-06**	**2E-06**	**8E-09**	**9E-06**
Sediment	As	1.5E+00	3.7E+00	NA	25.5	1E-08	9E-10	NA	2E-08	3E-09	NA	2E-08	51.2	3E-07	7E-08	NA	5E-07	3E-07	NA	7E-07
								Sediment CTE Subtotal =	**2E-08**	**3E-09**	**NA**	**2E-08**				**Sediment RME Subtotal =**	**5E-07**	**3E-07**	**NA**	**7E-07**
Surface Water	As	1.5E+00	3.7E+00	NA	0.002	2E-10	5E-10	NA	3E-10	2E-09	NA	2E-09	0.004	5E-09	5E-09	NA	7E-09	2E-08	NA	3E-08
								Surface Water CTE Subtotal =	**3E-10**	**2E-09**	**NA**	**2E-09**				**Surface Water RME Subtotal =**	**7E-09**	**2E-08**	**NA**	**3E-08**
								Total CTE Carcinogenic Risk =	**3E-07**	**2E-07**	**7E-10**	**5E-07**				**Total RME Carcinogenic Risk =**	**7E-06**	**3E-06**	**8E-09**	**1E-05**

Notes:

COPC = Contaminant of potential concern

CTE = Central tendency exposure

EPC = Exposure point concentration

NA = Not applicable

RME = Reasonable maximum exposure

mg/kg-day = Milligram per kilogram per day

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE A.8c
Carcinogenic Risks - Adult Worker
Rabbit Mine

					CENTRAL TENDENCY EXPOSURE SCENARIO								REASONABLE MAXIMUM EXPOSURE SCENARIO							
		Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$			CTE EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Carcinogenic Risk by Exposure Route			CTE Total Risk	RME EPC (mg/kg); (mg/L)	Average Daily Dose (mg/kg-day)			Carcinogenic Risk by Exposure Route			RME Total Risk
Media	COPC	Oral	Dermal	Inhalation		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation			Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation	
Mine Waste	As	1.5E+00	3.7E+00	1.5E+01	204	5E-07	1E-07	5E-11	7E-07	5E-07	7E-10	**1E-06**	396	4E-05	8E-06	5E-10	**6E-05**	**3E-05**	8E-09	**8E-05**
								Mine Waste CTE Subtotal =	**7E-07**	**5E-07**	**7E-10**	**1E-06**				**Mine Waste RME Subtotal =**	**6E-05**	**3E-05**	**8E-09**	**8E-05**
Sediment	As	1.5E+00	3.7E+00	NA	25.5	1E-08	2E-09	NA	2E-08	9E-09	NA	3E-08	51.2	5E-07	1E-06	NA	8E-07	4E-06	NA	4E-06
								Sediment CTE Subtotal =	**2E-08**	**9E-09**	**NA**	**3E-08**				**Sediment RME Subtotal =**	**8E-07**	**4E-06**	**NA**	**4E-06**
Surface Water	As	1.5E+00	3.7E+00	NA	0.002	2E-10	6E-10	NA	4E-10	2E-09	NA	3E-09	0.004	8E-09	2E-08	NA	1E-08	7E-08	NA	8E-08
								Surface Water CTE Subtotal =	**4E-10**	**2E-09**	**NA**	**3E-09**				**Surface Water RME Subtotal =**	**1E-08**	**7E-08**	**NA**	**8E-08**
								Total CTE Carcinogenic Risk =	**7E-07**	**5E-07**	**7E-10**	**1E-06**				**Total RME Carcinogenic Risk =**	**6E-05**	**3E-05**	**8E-09**	**9E-05**

Notes:

COPC = Contaminant of potential concern

CTE = Central tendency exposure

EPC = Exposure point concentration

NA = Not applicable

RME = Reasonable maximum exposure

mg/kg-day = Milligram per kilogram per day

mg/kg = Milligram per kilogram

mg/L = Milligram per liter

TABLE A.9

Summary of Human Health Non-carcinogenic Hazards and Carcinogenic Risks

Rabbit Mine

Media and Exposure Pathway	CENTRAL TENDENCY EXPOSURE						REASONABLE MAXIMUM EXPOSURE					
	NON-CARCINOGENIC HAZARD			CARCINOGENIC RISK			NON-CARCINOGENIC HAZARD			CARCINOGENIC RISK		
	Recreationalist Child	Recreationalist Adult	Worker Adult	Recreationalist Child	Recreationalist Adult	Worker Adult	Recreationalist Child	Recreationalist Adult	Worker Adult	Recreationalist Child	Recreationalist Adult	Worker Adult
Mine Waste:												
Ingestion	0.02	0.01	0.02	5.E-07	3.E-07	7.E-07	0.2	0.04	0.4	**7.E-06**	**7.E-06**	**6.E-05**
Dermal	0.01	0.004	0.01	3.E-07	2.E-07	5.E-07	0.1	0.01	0.2	**4.E-06**	**2.E-06**	**3.E-05**
Inhalation	NA	NA	NA	3.E-10	7.E-10	7.E-10	NA	NA	NA	1.E-09	8.E-09	8.E-09
Subtotal =	0.02	0.01	0.04	8.E-07	5.E-07	**1.E-06**	0.3	0.1	0.6	**1.E-05**	**9.E-06**	**8.E-05**
Sediment:												
Ingestion	0.002	0.001	0.001	3.E-08	2.E-08	2.E-08	0.02	0.004	0.01	5.E-07	5.E-07	8.E-07
Dermal	0.0001	0.0001	0.0002	5.E-09	3.E-09	9.E-09	0.01	0.001	0.02	5.E-07	3.E-07	**4.E-06**
Subtotal =	0.002	0.001	0.002	3.E-08	2.E-08	3.E-08	0.04	0.01	0.03	**1.E-06**	7.E-07	**4.E-06**
Surface Water												
Ingestion	0.00001	0.00001	0.00001	5.E-10	3.E-10	4.E-10	0.0001	0.00004	0.0001	3.E-09	7.E-09	1.E-08
Dermal	0.00002	0.00003	0.00006	7.E-10	2.E-09	2.E-09	0.0001	0.0001	0.0005	2.E-09	2.E-08	7.E-08
Subtotal =	0.00003	0.00004	0.00007	1.E-09	2.E-09	3.E-09	0.0001	0.0001	0.001	5.E-09	3.E-08	8.E-08
TOTAL =	0.03	0.01	0.04	8.E-07	5.E-07	**1.E-06**	0.4	0.1	0.6	**1.E-05**	**1.E-05**	**9.E-05**

Pathway Totals:

Ingestion	0.02	0.01	0.03	5.E-07	3.E-07	7.E-07	0.2	0.05	0.4	**8.E-06**	**7.E-06**	**6.E-05**
Dermal	0.01	0.004	0.01	3.E-07	2.E-07	5.E-07	0.1	0.01	0.2	**4.E-06**	**3.E-06**	**3.E-05**
Inhalation	NA	NA	NA	3.E-10	7.E-10	7.E-10	NA	NA	NA	1.E-09	8.E-09	8.E-09

Notes:

Bold values exceed risk screening levels.

ATTACHMENT B

ECOLOGICAL RISK CALCULATION TABLES

TABLE B.1
Preliminary Contaminant of Potential Ecological Concern Screening - Mine Waste
Rabbit Mine
(results reported in mg/kg)

Analyte	Minimum Detected Concentration	Maximum Detected Concentration	90% UCL[a]	Essential Nutrient?	Retain For Screening?	Detection Frequency	Retain for Screening?	Background 90% UCL[a]	Retain for Risk-based Screening?
Antimony	6.4	14.2	9.49	No	**Yes**	100%	**Yes**	4.16	**Yes**
Arsenic III	*7.50*	*7.50*	*7.50*	No	**Yes**	0%	No	*7.5*	No
Arsenic V	52.3	723	698	No	**Yes**	100%	**Yes**	*7.7*	**Yes**
Arsenic Total	*6.70*	1280	396	No	**Yes**	100%	**Yes**	2.9	**Yes**
Cadmium	*0.10*	2.8	2.76	No	**Yes**	47%	**Yes**	0.86	**Yes**
Chromium Total	25.5	141	77	No	**Yes**	100%	**Yes**	42.4	**Yes**
Copper	65.5	118	92	No	**Yes**	100%	**Yes**	35.3	**Yes**
Cyanide WAD	*0.250*	*0.250*	*0.250*	No	**Yes**	0%	No	NA	No
Cyanide Total	*0.25*	*0.25*	*0.25*	No	**Yes**	0%	No	NA	No
Iron	43350	86100	61000	**Yes**	No	100%	**Yes**	34300	**Yes**[b]
Lead	0.96	194	44	No	**Yes**	100%	**Yes**	4.88	**Yes**
Mercury	*0.017*	2.63	1.21	No	**Yes**	93%	**Yes**	0.041	**Yes**
Nickel	40.5	79.9	62.9	No	**Yes**	100%	**Yes**	33.8	**Yes**
Selenium	*2.0*	*2.0*	*2.0*	No	**Yes**	0%	No	*2.0*	No
Silver	*0.25*	0.71	*0.71*	No	**Yes**	7%	**Yes**	*0.25*	**Yes**
Zinc	38.4	270	270	No	**Yes**	100%	**Yes**	45.0	**Yes**

Notes:

[a]If the calculated 90% upper confidence limit (UCL) was greater than the maximum detected concentration (MDC), or was unable to be calculated, the MDC was used.

[b]Although an essential nutrient, retained because 90% UCL exceeds the Level II SLV for iron in soil in ODEQ's *"Guidance for Ecological Risk Assessment"* (2001).

Italicized results indicate result below laboratory reporting limit (RL), value = 1/2 RL.

mg/kg = Milligram per kilogram

NA = Not analyzed

TABLE B.2
Preliminary Contaminant of Potential Ecological Concern Screening - Surface Water
Rabbit Mine
(results reported in mg/L)

Analyte	Minimum Detected Concentration	Maximum Detected Concentration	90% UCL[a]	Essential Nutrient?	Retain for Screening?	Detection Frequency	Retain for Screening?	Background MDC[b]	Retain for Risk-based Screening?
Antimony	*0.00150*	*0.00150*	*0.00150*	No	**Yes**	0%	No	*0.00150*	No
Arsenic III	*0.00150*	*0.00150*	*0.00150*	No	**Yes**	0%	No	*0.00150*	No
Arsenic V	0.00385	0.00385	0.00385	No	**Yes**	100%	**Yes**	*0.00150*	**Yes**
Arsenic	*0.00150*	0.00385	0.00385	No	**Yes**	33%	**Yes**	*0.00150*	**Yes**
Cadmium	*0.000100*	*0.000100*	*0.000100*	No	**Yes**	0%	No	*0.000100*	No
Calcium	15.60	23.1	23.1	**Yes**	No	100%	**Yes**	13.2	No[c]
Chromium	*0.00125*	*0.00125*	*0.00125*	No	**Yes**	0%	No	*0.00125*	No
Copper	*0.00050*	*0.00050*	*0.00050*	No	**Yes**	0%	No	0.00087	No
Cyanide WAD	*0.0050*	*0.0050*	*0.0050*	No	**Yes**	0%	No	*0.0050*	No
Cyanide Total	*0.0050*	*0.0050*	*0.0050*	No	**Yes**	0%	No	*0.0050*	No
Iron	*0.030*	0.101	0.101	**Yes**	No	33%	**Yes**	*0.030*	No[c]
Lead	*0.00150*	*0.00150*	*0.00150*	No	**Yes**	0%	No	*0.00150*	No
Magnesium	3.85	4.90	4.90	**Yes**	No	100%	**Yes**	3.71	No[c]
Mercury	*0.00010*	*0.00010*	*0.00010*	No	**Yes**	0%	No	*0.00010*	No
Nickel	*0.00050*	*0.00050*	*0.00050*	No	**Yes**	0%	No	*0.00050*	No
Selenium	*0.00150*	*0.00150*	*0.00150*	No	**Yes**	0%	No	*0.00150*	No
Silver	*0.000063*	*0.000063*	*0.000063*	No	**Yes**	0%	No	*0.000063*	No
Zinc	*0.0050*	*0.0050*	*0.0050*	No	**Yes**	0%	No	*0.0050*	No

Notes:

[a]If the calculated 90% upper confidence limit (UCL) was greater than the maximum detected concentration (MDC), or was unable to calculated, the MDC was used.

[b]Due to the small number of background samples collected, the 90% UCL was unable to be calculated; thus, the MDC is used.

[c]Not retained because the analyte is an essential nutrient and below the Level II SLVs from ODEQ's *"Guidance for Ecological Risk Assessment"* (2001).

Italicized results indicate result below laboratory reporting limit (RL), value = 1/2 RL.

mg/L = Milligram per liter

SLV = Screening level value

WAD = Weak acid dissociable

TABLE B.3
Preliminary Contaminant of Potential Ecological Concern Screening - Sediment
Rabbit Mine
(results reported in mg/kg)

Analyte	Minimum Detected Concentration	Maximum Detected Concentration	90% UCL[a]	Essential Nutrient?	Retain for Screening?	Detection Frequency	Retain for Screening?
Antimony	*1.0*	*1.0*	*1.0*	No	**Yes**	0%	No
Arsenic III	*7.5*	*7.5*	*7.5*	No	**Yes**	0%	No
Arsenic V	*7.7*	*7.7*	*7.7*	No	**Yes**	0%	No
Arsenic Total	7.1	52.1	51.2	No	**Yes**	100%	**Yes**
Cadmium	*0.10*	0.22	0.22	No	**Yes**	33%	**Yes**
Chromium Total	29.4	57.5	57.5	No	**Yes**	100%	**Yes**
Copper	38.4	60.5	59.9	No	**Yes**	100%	**Yes**
Cyanide WAD	*1.25*	*1.25*	*1.25*	No	**Yes**	0%	No
Cyanide Total	*0.25*	*0.25*	*0.25*	No	**Yes**	0%	No
Iron	23300	42800	42800	**Yes**	No	100%	No[b]
Lead	2.66	5.49	5.49	No	**Yes**	100%	**Yes**
Mercury	0.060	0.088	0.087	No	**Yes**	100%	**Yes**
Nickel	21.5	37.7	37.7	No	**Yes**	100%	**Yes**
Selenium	*2.0*	*2.0*	*2.0*	No	**Yes**	0%	No
Silver	*0.25*	*0.25*	*0.25*	No	**Yes**	0%	No
Zinc	30.6	46.1	46.1	No	**Yes**	100%	**Yes**

Notes:

[a]If the calculated 90% upper confidence limit (UCL) was greater than the maximum detected concentration (MDC), or was unable to calculated, the MDC was used.

[b]Not retained because iron is an essential nutrient and there are no Level II SLVs for iron in sediment in the ODEQ's*"Guidance for Ecological Risk Assessment"* (2001).

Italicized results indicate result below laboratory reporting limit (RL), value = 1/2 RL.

No background sediment samples were collected; thus, background screening not conducted.

mg/kg = Milligram per kilogram

WAD = Weak acid dissociable

TABLE B.4
Preliminary Contaminant of Potential Ecological Concern Screening - Pore Water
Rabbit Mine
(results reported in mg/L)

Analyte	Minimum Detected Concentration	Maximum Detected Concentration	90% UCL[a]	Essential Nutrient?	Retain for Screening?	Detection Frequency	Retain for Screening?
Antimony	*0.00150*	*0.00150*	*0.00150*	No	**Yes**	0%	No
Arsenic	*0.00150*	*0.00150*	*0.00150*	No	**Yes**	0%	No
Cadmium	*0.00010*	*0.00010*	*0.00010*	**Yes**	No	0%	No
Calcium	18.7	24.4	24.2	No	**Yes**	100%	No[b]
Chromium	*0.00125*	*0.00125*	*0.00125*	No	**Yes**	0%	No
Copper	*0.00050*	*0.00050*	*0.00050*	No	**Yes**	0%	No
Cyanide WAD	*0.0050*	*0.0050*	*0.0050*	No	**Yes**	0%	No
Cyanide Total	*0.0050*	*0.0050*	*0.0050*	No	**Yes**	0%	No
Iron	*0.030*	0.158	0.158	**Yes**	No	33%	No[b]
Magnesium	6.04	8.62	8.59	**Yes**	No	100%	No[b]
Mercury	*0.00010*	*0.00010*	*0.00010*	No	**Yes**	0%	No
Nickel	*0.00050*	*0.00050*	*0.00050*	No	**Yes**	0%	No
Selenium	*0.00150*	*0.00150*	*0.00150*	No	**Yes**	0%	No
Silver	*0.000063*	*0.000063*	*0.000063*	No	**Yes**	0%	No
Zinc	*0.0050*	*0.0050*	*0.0050*	No	**Yes**	0%	No

Notes:

[a]If the calculated 90% upper confidence limit (UCL) was greater than the maximum detected concentration (MDC), or was unable to calculated, the MDC was used.

[b]Not retained because the analyte is an essential nutrient and there are no Level II SLVs for pore water in ODEQ's*"Guidance for Ecological Risk Assessment"* (2001).

No background pore water samples were collected; thus, background screening not conducted.

Italicized results indicate result below laboratory reporting limit (RL), value = 1/2 RL.

mg/L = Milligram per liter

WAD = Weak acid dissociable

TABLE B.5
Chemistry Toxicity Screening - Mine Waste
Rabbit Mine
(results reported in mg/kg)

			SCREENING LEVEL VALUE[d]				SINGLE COI RISK RATIO (T_{ij} = EPC/SLV)				RISK TO RECEPTORS? (T_{ij} > 5)[f]				CPEC?	MULTIPLE COI RISK RATIO ($T_{mult} = T_{ij}/T_j$)				MULTIPLE COI RISK TO RECEPTORS? (T_{ij}/T_j) > ($5/N_{ij}$)[f]				CPEC?	Bioaccumulator CPEC?
Analyte[a]	**EPC (MDC)[b]**	**EPC (90% UCL)[c]**	**Plant**	**Invertebrate**	**Bird**	**Mammal**	**Plant**	**Invertebrate**	**Bird**	**Mammal**	**Plant**	**Invertebrate**	**Bird**	**Mammal**		**Plant**	**Invertebrate**	**Bird**	**Mammal**	**Plant**	**Invertebrate**	**Bird**	**Mammal**		
Antimony	14.2	9.49	5	NS	NS	15	2.8	-	-	0.63	No	No	No	No	**Yes**[e]	0.0	-	-	0.61	No	No	No	No	**Yes**[e]	No
Arsenic V	723	698	NS	NS	NS	NS	-	-	-	-	No	No	No	No	**Yes**[e]	-	-	-	-	No	No	No	No	**Yes**[e]	No
Arsenic Total	1280	396	NS	NS	NS	NS	-	-	-	-	No	No	No	No	**Yes**[e]	-	-	-	-	No	No	No	No	**Yes**[e]	No
Cadmium	2.76	2.76	4	20	6	125	0.7	0.1	0.5	0.02	No	No	No	No	No	0.0	0.00	0.05	0.02	No	No	No	No	No	**Yes**
Chromium Total	141	77	NS	NS	NS	NS	-	-	-	-	No	No	No	No	**Yes**[e]	-	-	-	-	No	No	No	No	**Yes**[e]	No
Copper	118	92	100	50	190	390	1.2	2.4	0.5	0.23	No	No	No	No	No	0.0	0.01	0.05	0.23	No	No	No	No	No	**Yes**
Iron	86100	61000	10	200	NS	NS	8610	431	-	-	**Yes**	**Yes**	No	No	**Yes**	1.0	0.93	-	-	**Yes**	**Yes**	No	No	**Yes**	No
Lead	194	44	50	500	16	4000	3.9	0.4	2.8	0.01	No	No	No	No	No	0.0	0.00	0.30	0.01	No	No	No	No	No	No
Mercury	2.63	1.21	0.3	0.1	1.5	73	8.8	26.3	0.8	0.02	**Yes**	**Yes**	No	No	**Yes**	0.0	0.06	0.09	0.02	No	No	No	No	No	**Yes**
Nickel	79.9	62.9	30	200	320	625	2.7	0.4	0.2	0.10	No	No	No	No	No	0.0	0.00	0.02	0.10	No	No	No	No	No	No
Silver	0.71	*0.71*	2	50	NS	NS	0.4	0.01	-	-	No	No	No	No	**Yes**[e]	0.0	0.00	-	-	No	No	No	No	**Yes**[e]	**Yes**
Zinc	270	270	50	200	60	20000	5.4	1.4	4.5	0.01	**Yes**	No	No	No	**Yes**	0.0	0.00	0.49	0.01	No	No	No	No	No	**Yes**
					Sum of T_{ij} (T_j) =		8636	461	9	1															
					# of COIs (N_{ij}) =		9	8	6	7															
					$5/N_{ij}$ =		0.6	0.6	0.8	0.71															

Notes:
[a]Contaminants retained after preliminary screening (essential nutrient, detection frequency, and background concentration comparison).
[b]The EPC used for plant and invertebrate receptors is the MDC.
[c]The EPC used for bird and mammal receptors is the 90% UCL.
[d]SLVs are from ODEQ's *"Guidance for Ecological Risk Assessment"*, Level II Screening Level Values (2001).
[e]Retained because of the lack of an SLV.
[f]A screening risk ratio of 5 was used for non-protected species. No listed threatened and endangered plants, invertebrates, birds, or mammals are expected to be at the Site.
mg/kg = Milligram per kilogram
COI = Contaminant of interest
CPEC = Contaminant of potential ecological concern
EPC = Exposure point concentration
MDC = Maximum detected concentration
NS = No SLV
ODEQ = Oregon Department of Environmental Quality
SLV = Screening level value

TABLE B.6
Chemistry Toxicity Screening - Surface Water
Rabbit Mine
(results reported in mg/L)

		SCREENING LEVEL VALUE[b,d]			SINGLE COI RISK RATIO (T_{ij} = EPC/SLV)			RISK TO RECEPTORS? (T_{ij}>5)[c]			CPEC?	MULTIPLE COI RISK RATIO (T_{ij}/T_j)			MULTIPLE COI RISK TO RECEPTORS (T_{ij}/T_i) > ($5/N_{ij}$)			CPEC?
Analyte[a]	**EPC (90% UCL)**	**Aquatic Life**	**Bird**	**Mammal**	**Aquatic Life**	**Bird**	**Mammal**	**Aquatic Life**	**Bird**	**Mammal**		**Aquatic Life**	**Bird**	**Mammal**	**Aquatic Life**	**Bird**	**Mammal**	
Arsenic V	0.00385	150	NS	NS	0.00003	-	-	No	No	No	**Yes[e]**	1.0000	-	-	No	No	No	**Yes[e]**
Arsenic Total	0.00385	NS	NS	NS	-	-	-	No	No	No	**Yes[e]**	-	-	-	No	No	No	**Yes[e]**
				Sum of T_{ij} (T_j) =	0.00003	-	0.0000											
				# COIs (N_{ij}) =	1	-	0											
				$5/N_{ij}$ =	5	-	-											

Notes:

[a]Contaminants retained after preliminary screening (essential nutrient, detection frequency, and background concentration comparison).

[b]SLVs corrected for hardness and dissolved fraction where applicable.

[c]A screening risk ratio of 5 was used for non-protected species. No listed threatened and endangered aquatic life, birds, or mammals are present at the Site.

[d]SLVs are from ODEQ's *"Guidance for Ecological Risk Assessment"*, Level II Screening Level Values (2001).

[e]Retained because of the lack of an SLV.

[f]Not retained as the risk ratio is below the SLV for aquatic life and is an essential nutrient.

mg/L = Milligram per liter

COI = Contaminant of interest

CPEC = Contaminant of potential ecological concern

EPC = Exposure point concentration

NS = No SLV

ODEQ = Oregon Department of Environmental Quality

SLV = Screening level value

UCL = Upper confidence limit

TABLE B.7
Chemistry Toxicity Screening - Sediment
Rabbit Mine
(results reported in mg/kg)

		SCREENING LEVEL VALUE[d]		SINGLE COI RISK RATIO (T_{ij} = EPC/SLV)		RISK TO RECEPTORS (T_{ij}>5)[c]		CPEC?
Analyte[a]	**EPC (MDC)[b]**	**Freshwater Sediment**	**Bioaccumulation**	**Freshwater Sediment**	**Bioaccumulation**	**Freshwater Sediment**	**Bioaccumulation**	
Arsenic Total	52.1	NS	NS	-	-	No	No	**Yes[e]**
Cadmium	0.22	0.6	0.003	0.37	73	No	**Yes**	**Yes**
Chromium Total	57.5	37	4200	1.6	0.0	No	No	No
Copper	60.5	36	10	1.7	6.1	No	**Yes**	**Yes**
Lead	5.49	35	128	0.16	0.04	No	No	No
Mercury	0.088	0.2	NS	0.4	-	No	No	**Yes[e]**
Nickel	37.7	18	316	2.1	0.1	No	No	No
Zinc	46.1	123	3	0.4	15.4	No	**Yes**	**Yes**

Notes:

[a]Contaminants retained after preliminary screening (essential nutrient and detection frequency).

[b]MDC values were used as 90% UCL values were not able to be calculated (fewer than four samples were analyzed).

[c]A screening risk ratio of 5 was used for non-protected species. No listed threatened and endangered aquatic life, birds, or mammals are present at the Site.

[d]SLVs are from ODEQ's *"Guidance for Ecological Risk Assessment"*, Level II Screening Level Values (2001).

[e]Retained because of the lack of an SLV.

mg/kg = Milligram per kilogram

CPEC = Contaminant of potential ecological concern

EPC = Exposure point concentration

NS = No SLV

ODEQ = Oregon Department of Environmental Quality

SLV = Screening level value

UCL = Upper confidence limit

TABLE B.8
Chemistry Toxicity Screening - Pore Water
Rabbit Mine
(results reported in mg/L)

Analyte[a]	EPC (MDC)[b]	AQUATIC LIFE						
		SCREENING LEVEL VALUE[c]	SINGLE COI RISK RATIO (T_{ij})	RISK TO RECEPTORS (T_{ij}>5)[d]	CPEC?	MULTIPLE COI RISK RATIO (T_{ij}/T_i)	RISK TO RECEPTORS (T_{ij}/T_i) > ($5/N_{ij}$)[d]	CPEC?
Arsenic Total	0.00150	NS	-	No	Yes[e]	-	No	Yes[e]
		Sum of T_{ij} (T_j) =	0.0					
		# COIs (N_{ij}) =	0					
		$5/N_{ij}$ =	-					

Notes:

[a]Contaminants retained after preliminary screening (essential nutrient and detection frequency).

[b]MDC values were used as 90% UCL values were not able to be calculated (fewer than four samples were analyzed).

[c]SLVs are from ODEQ's *"Guidance for Ecological Risk Assessment"* , Surface Water Level II Screening Level Values (2001).

[d]A screening risk ratio of 5 was used for non-protected species. No listed threatened and endangered aquatic life, birds, or mammals are present at the Site.

[e]Retained because of the lack of an SLV.

COI = Contaminant of interest

CPEC = Contaminant of potential ecological concern

EPC= Exposure point concentration

MDC = Maximum detected concentration

mg/L = Milligram per liter

NS = No SLV

ODEQ = Oregon Department of Environmental Quality

SLV = Screening level value

TABLE B.9
Chemistry Toxicity Screening - Multiple Media
Rabbit Mine

	Single COI Risk Ratio (T_{ij})				Multiple Media Risk Ratio (T_{ij}-mine waste + T_{ij}-surface water)		Risk to Receptor ($T_{ij\text{-combined}}$>5)		CPEC?
	Mine Waste		Surface Water						
Analyte[a]	**Bird**	**Mammal**	**Bird**	**Mammal**	**Bird**	**Mammal**	**Bird**	**Mammal**	
Antimony	-	0.63	-	-	-	0.63	No	No	No
Arsenic V	-	-	-	-	-	-	No	No	No
Arsenic Total	-	-	-	-	-	-	No	No	No
Cadmium	0.5	0.02	-	-	0.5	0.02	No	No	No
Chromium Total	-	-	-	-	-	-	No	No	No
Copper	0.5	0.23	-	-	0.5	0.23	No	No	No
Iron	-	-	-	-	-	-	No	No	No
Lead	2.8	0.01	-	-	2.8	0.01	No	No	No
Mercury	0.8	0.02	-	-	0.8	0.02	No	No	No
Nickel	0.2	0.10	-	-	0.2	0.10	No	No	No
Silver	-	-	-	-	-	-	No	No	No
Zinc	4.5	0.01	-	-	4.5	0.01	No	No	No

Notes:

[a]Contaminants retained after preliminary screening (essential nutrient, detection frequency, and background concentration comparison).

COI = Contaminant of interest

CPEC = Contaminant of potential ecological concern

ATTACHMENT C

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY ECOLOGICAL SCOPING CHECKLIST

ATTACHMENT 1
Ecological Scoping Checklist

Site Name	Rabbit
Date of Site Visit	6/19/08
Site Location	Oregon
Site Visit Conducted by	T. Douglass, M. Puett, P. Tibbetts

Part ❶

CONTAMINANTS OF INTEREST Types, Classes, Or Specific Hazardous Substances ‡ Known Or Suspected	Onsite	Adjacent to or in locality of the facility †
Gold mine tailings		

‡ As defined by OAR 340-122-115(30) † As defined by OAR 340-122-115(34)

Part ❷

OBSERVED IMPACTS ASSOCIATED WITH THE SITE	Finding
Onsite vegetation (None, Limited, Extensive)	Limited
Vegetation in the locality of the site (None, Limited, Extensive)	Limited
Onsite wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other (None, Limited, Extensive)	Limited
Wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other in the locality of the site (None, Limited, Extensive)	None
Other readily observable impacts (None, Discuss below)	None
Discussion:	

ATTACHMENT 1
Ecological Scoping Checklist (cont'd)

Part ❸

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding
Terrestrial - Wooded	
Percentage of site that is wooded	70%
Dominant vegetation type (Evergreen, Deciduous, Mixed)	E P *
Prominent tree size at breast height, i.e., four feet (<6", 6" to 12", >12")	6 to 12"
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	M, B, Mam
Terrestrial - Scrub/Shrub/Grasses	
Percentage of site that is scrub/shrub	20%
Dominant vegetation type (Scrub, Shrub, Grasses, Other)	Sh P
Prominent height of vegetation (<2', 2' to 5', >5')	2-5
Density of vegetation (Dense, Patchy, Sparse)	P P
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	
Terrestrial - Ruderal	
Percentage of site that is ruderal	60%
Dominant vegetation type (Landscaped, Agriculture, Bare ground)	Landscp P
Prominent height of vegetation (0', >0' to <2', 2' to 5', >5')	
Density of vegetation (Dense, Patchy, Sparse)	Sparse P
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	
Aquatic - Non-flowing (lentic)	
Percentage of site that is covered by lakes or ponds	2%
Type of water bodies (Lakes, Ponds, Vernal pools, Impoundments, Lagoon, Reservoir, Canal)	Vernal pool
Size (acres), average depth (feet), trophic status of water bodies	Ft Deep - 120 ft²
Source water (River, Stream, Groundwater, Industrial discharge, Surface water runoff)	Su
Water discharge point (None, River, Stream, Groundwater, Wetlands impoundment)	None
Nature of bottom (Muddy, Rocky, Sand, Concrete, Other)	Muddy P
Vegetation present (Submerged, Emergent, Floating)	None P
Obvious wetlands present (Yes / No)	None
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	None
Aquatic - Flowing (lotic)	
Percentage of site that is covered by rivers, streams (brooks, creeks), intermittent streams, dry wash, arroyo, ditches, or channel waterway	1%
Type of water bodies (Rivers, Streams, Intermittent Streams, Dry wash, Arroyo, Ditches, Channel waterway)	Inter. Stream
Size (acres), average depth (feet), approximate flow rate (cfs) of water bodies	see fieldnotes
Bank environment (cover: Vegetated, Bare / slope: Steep, Gradual / height (in feet))	V/Gradu
Source water (River, Stream, Groundwater, Industrial discharge, Surface water runoff)	Addit - GW
Tidal influence (Yes / No)	No
Water discharge point (None, River, Stream, Groundwater, Wetlands impoundment)	St R
Nature of bottom (Muddy, Rocky, Sand, Concrete, Other)	
Vegetation present (Submerged, Emergent, Floating)	S/E P
Obvious wetlands present (Yes / No)	No
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds,	M/B/Mam

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding
Mammals, Other)	
Aquatic - Wetlands	
Obvious or designated wetlands present (Yes / No)	NO
Wetlands suspected as site is/has (Adjacent to water body, in Floodplain, Standing water, Dark wet soils, Mud cracks, Debris line, Water marks)	
Vegetation present (Submerged, Emergent, Scrub/shrub, Wooded)	P
Size (acres) and depth (feet) of suspected wetlands	
Source water (River, Stream, Groundwater, Industrial discharge, Surface water runoff)	
Water discharge point (None, River, Stream, Groundwater, Impoundment)	
Tidal influence (Yes / No)	
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	

* **P**: Photographic documentation of these features is highly recommended.

Part ❹

ECOLOGICALLY IMPORTANT SPECIES / HABITATS OBSERVED
None Observed – SOC or E/T Species

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surface waters? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via surface water?**			
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in surface waters. • Ability of hazardous substances to migrate to surface waters. • Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters. Aquatic receptors may be exposed through osmotic exchange, respiration or ventilation of surface waters. • Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters. • Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.			
Are hazardous substances present or potentially present in groundwater? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via groundwater?**			
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in groundwater. • Ability of hazardous substances to migrate to groundwater. • Potential for hazardous substances to migrate via groundwater and discharge into habitats and/or surface waters. • Contaminants may be taken-up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1m depth). • Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in sediments? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via contact with sediments?**			
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in sediment. • Ability of hazardous substances to leach or erode from surface soils and be carried into sediment via surface runoff. • Potential for contaminated groundwater to upwell through, and deposit contaminants in, sediments. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods. Aquatic receptors may be directly exposed to sediments or may be exposed through osmotic exchange, respiration or ventilation of sediment pore waters. • Terrestrial plants may be exposed to sediment in an area that is only periodically inundated with water. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may have direct access to sediments for the purposes of incidental ingestion. Aquatic receptors may regularly or incidentally ingest sediment while foraging.	X X X X X		X
Are hazardous substances present or potentially present in prey or food items of ecologically important receptors? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via consumption of food items?**			
When answering the above questions, consider the following: • Higher trophic level terrestrial and aquatic consumers and predators may be exposed through consumption of contaminated food sources. • In general, organic contaminants with log K_{ow} > 3.5 may accumulate in terrestrial mammals and those with a log K_{ow} > 5 may accumulate in aquatic vertebrates.	X		X

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

APPENDIX C

SITE PHOTOGRAPHS

Photo 1: Main shaft and waste rock pile WR1 (Oct. 2007)

Photo 2: Close-up of main shaft (June 2008)

Photo 3: Air shaft and collapsed adit (Oct. 2007)

Photo 4: Close-up of air shaft (Oct. 2007)

Photo 5: Water discharging from flooded air shaft (June 2008)

Photo 6: Collapsed adit (June 2008)

Photo 7: View from collapsed adit (June 2008)

Photo 8: Waste rock pile WR2 (June 2008)

Photo 9: Mill area (Oct. 2007)

Photo 10: Mill area and waste rock pile WR1 (June 2008)

Photo 11: Waste rock pile WR1 and mill area (June 2008)

Photo 12: Disturbed soils below the mill area (June 2008)

Photo 13: Disturbed soils below the mill area (June 2008)

Photo 14: Placer deposit in stream channel (June 2008)

Photo 15: Placer deposit in stream channel (June 2008)

Photo 16: Waste rock around small pond (June 2008)

Photo 17: Cabin (June 2008)

Photo 18: Access road along Site (June 2008)

Photo 19: Surface water sampling location SW1 (June 2008)


Photo 20: Surface water sampling location SW2 (June 2008)

Photo 21: Surface water sampling location SW3 (June 2008)

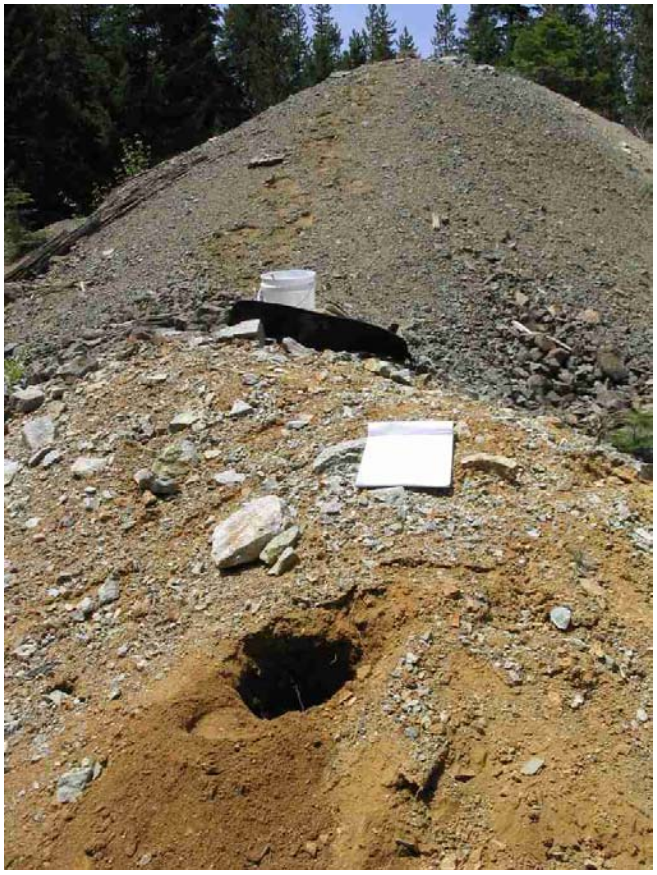
Photo 22: Lighter material on toe of waste rock pile WR1 at sample location WR6 (June 2008)

Photo 23: Potential repository/soil borrow source location from below (June 2008)

Photo 24: Potential repository/soil borrow source location from above (June 2008)

ADDENDUM 1

WORK CAMP INVESTIGATION

ADDENDUM 1 – WORK CAMP INVESTIGATION
Rabbit Mine Site Inspection
Wallowa-Whitman National Forest, Oregon — February 2009

Principal Author: Leslie A. Eldridge, P.E. Staff Engineer

Reviewed By: Michael J. Puett, P.E., Project Manager

Prepared For:

USDA Forest Service
Gifford Pinchot National Forest
10600 NE 51st Circle
Vancouver, WA 98682

Prepared by:

Millennium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
(208) 345-8292

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1.0 INTRODUCTION

- Millennium Science and Engineering, Inc. (MSE) was contracted by the United States Department of Agriculture, Forest Service (Forest Service) to perform a Site Inspection (SI) of the Rabbit Mine in the Wallowa-Whitman National Forest.
- During a preliminary reconnaissance of the Site in October 2007, MSE identified a work camp consisting of several cabins and miscellaneous wooden structures about 400 feet north/northwest of Rabbit Mine.
- It is believed that the camp supported several nearby mines in the area and was not part of the Rabbit Mine. Information about the Rabbit Mine is very limited and no mention of the work camp was found.
- The work camp is located on a ridge top and covers approximately 2 acres.
- Several potential environmental concerns were identified at the work camp, including:
  - A leaking 55-gallon drum containing a black tarry material characteristic of creosote;
  - A partially full 55-gallon drum laying on its side and labeled "76 Marok" (a rock drill lubricant);
  - Several empty or partially full containers of Coleman fuel and other products;
  - Two piles of partially burned debris (the smaller pile emanated a strong petroleum-based odor); and
  - Assorted car batteries and electrical insulators (mainly located in the large pile of debris and possibly containing asbestos- and/or polychlorinated biphenyl [PCB]-containing materials).

2.0 FIELD INVESTIGATION ACTIVITIES

- MSE conducted a field investigation of the work camp on June 20, 2008.
- Field investigation activities included:
  - Conducting a visual inspection of the work camp and associated structures to identify, inventory, and document the location, content, and condition of drums, physical hazards, and other features.
  - Delineating the areal extent of what appeared to be a creosote spill.
    - The spill covers and area approximately 2 to 3 feet wide by 15 feet long. Depth of affected soil appears to be about 1 to 3 inches.
  - Estimating the quantity of material contained in each pile of partially burned debris.
    - The small pile is circular, approximately 10 feet in diameter, and 1 foot thick. The estimated volume of debris and affected soil is about 3 bank cubic yards (bcy).
    - The larger pile is rectangular, approximately 20 feet wide, 50 feet long, and about 1 to 2 feet thick. The estimated volume of debris and affected soil is about 100 bcy
  - Collecting characterizations samples from:
    - The contents of two abandoned drums;
    - Soil near the leaking drum; and
    - Soil in the area of the two burned debris piles.
  - Site photographs taken during the field investigation are provided in Appendix A.

2.1 Sample Collection

- Soil and drum fluid samples were collected from the locations shown on Figure 1 and are summarized in Table 1.

- Characterization samples consisted of the following:
  - Soil samples collected from:
    - Small pile of debris (sample BD1-RT-C):
      - Three grab soil samples were collected at a depth of 3 to 6 inches utilizing disposable, single-use hand trowels.
      - Gravel and organic media were removed.
      - The grab samples were composited by combining in a 1-gallon plastic bag and thoroughly mixing.
      - The composite sample was analyzed for total petroleum hydrocarbons (TPH), 8 RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), volatile organic compounds (VOC), and Toxicity Characteristic Leaching Procedure (TCLP) metals.
    - Large pile of debris (sample BD2-RT-C):
      - Three grab soil samples were collected at a depth of 3 to 6 inches utilizing disposable, single-use hand trowels.
      - Gravel and organic media were removed.
      - The grab samples were composited by combining in a 1-gallon plastic bag and thoroughly mixing.
      - The composite sample was analyzed for TPH, 8 RCRA metals, VOCs, and TCLP metals.
    - Area around the leaking 55-gallon drum (sample DS1-RT-G):
      - One grab soil sample was collected at a depth of 3 to 6 inches utilizing a disposable, single-use hand trowel.
      - The sample was analyzed for VOCs, TPH, TCLP, and 8 RCRA metals.
  - Drum fluid samples collected from:
    - Leaking 55-gallon drum (sample LD1-RT-G):
      - The sample was analyzed for PCBs, VOCs, semi-volatile organic compounds (SVOC), and oil and grease (i.e. Hexane Extractable Materials [HEM]).
    - 55-gallon drum labeled "76 Marok":
      - The sample was analyzed for VOCs and oil and grease (HEM).
- All sample locations were flagged, photographed, and the GPS coordinates were recorded. Coordinates for samples BD1-RT-C and BD2-RT-C represent locations of the small and large piles of debris, respectively.
- All samples were preserved as appropriate for the required analysis. The sample containers were placed on ice in a cooler and shipped to SVL Analytical (SVL) in Kellogg, Idaho under strict chain-of-custody procedures.

3.0 ANALYTICAL RESULTS

- Analytical results from the soil samples are summarized in Tables 2 and 3. Results from the drum fluid samples are summarized in Table 4.
- Small pile of debris (sample BD1-RT-C):
  - Arsenic, barium, chromium, lead, mercury, and lube oil were detected in the composite sample.
  - The concentrations of arsenic, chromium, mercury, and lead were compared to the 90 percent upper confidence limit (UCL_{90}) concentrations in background soil samples collected at the nearby Rabbit Mine. Arsenic, mercury, and lead exceeded the background soil UCL_{90} concentrations as follows:
    - Arsenic (4.6 milligrams per kilogram [mg/kg] versus non-detect in background samples)
    - Mercury (0.078 mg/kg versus 0.041 mg/kg in background samples)

    - Lead (14.3 mg/kg versus 4.88 mg/kg in background samples)
  - The reported concentration of lube oil was 125 mg/kg; diesel was not detected above the laboratory reporting limit (RL). The RL is considered the lowest concentration of an analyte that can be accurately "measured" and is different from the method detection limit (MDL), which is the minimum concentration that can be detected. The RL is set by each laboratory and commonly ranges from 2 to 5X the MDL.
  - Mercury was the only compound detected in the TCLP extract, with a reported concentration of 0.0004 milligrams per liter (mg/L), which is well below the RCRA disposal limit.
- Large pile of debris (sample BD2-RT-C):
  - Arsenic, barium, cadmium, chromium, lead, mercury, and lube oil were detected in the composite sample.
  - The concentrations of arsenic, cadmium, chromium, lead, and mercury were compared with the UCL_{90} concentrations in background soil samples collected at the nearby Rabbit Mine. Arsenic, cadmium, mercury, and lead exceeded the background soil UCL_{90} concentrations as follows:
    - Arsenic (16.3 mg/kg versus non-detect in background samples)
    - Cadmium (26.1 mg/kg versus 0.86 mg/kg in background samples)
    - Mercury (5.85 mg/kg versus 0.041 mg/kg in background samples)
    - Lead (1,130 mg/kg versus 4.88 mg/kg in background samples)
  - The reported concentration of lube oil was 105 mg/kg; diesel was not detected above the RL.
  - Barium, cadmium, and lead were detected in the TCLP extract; however, their reported concentrations were well below the RCRA disposal limits.
- Soil from around the leaking 55-gallon drum (sample DS1-RT-G):
  - Several metals, including barium, chromium, mercury, and lead were detected above the RL in the grab sample. The RL is the lowest concentration at which an analyte can be accurately measured in a sample. Only mercury was above the background soil UCL_{90} concentration from the nearby Rabbit Mine (0.058 mg/kg versus 0.041 mg/kg in background samples)
  - Multiple VOCs and SVOCs, including naphthalene, 1,2,4-trimethylbenzene, and o-xylene were also detected.
  - Diesel was reported at a concentration of 3,190 mg/kg; lube oil was reported at a concentration of 2,000 mg/kg.
  - Mercury was the only compound detected in the TCLP extract, with a reported concentration of 0.0003 mg/L (well below the RCRA disposal limit).
- Fluid from leaking 55-gallon drum (sample LD1-RT-G):
  - Numerous VOCs and SVOCs were reported at concentrations above the RLs.
  - No PCBs were reported at concentrations above the RL.
  - The three compounds with the highest reported concentrations included naphthalene (67.2 mg/L), phenanthrene (6.78 mg/L), and 2-methylnapthalene (6.11 mg/L).
  - The fluid was reported to contain ~100 percent HEM.
  - Analytical data suggests that the fluid leaking from the 55-gallon drum is creosote.
- Fluid from the 55-gallon drum labeled "76 Marok" (sample MD1-RT-G):
  - Naphthalene was detected at a concentration of 0.129 mg/L.
  - Oil and grease (as HEM) was detected at a concentration of 131.0 mg/L.
  - No other compounds were detected in the grab sample.

4.0 ABBREVIATED HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

- Analytical results from the three soil samples collected during the field investigation were compared with human health and ecological risk screening criteria to assess potential risks associated with exposure to contaminants at the work camp.
- Criteria are presented in Tables 2 and 5 and include:
  - U.S. Bureau of Land Management (BLM) Risk Management Criteria for Metals at BLM Mining Sites ([RMC] Ford 2004);
  - EPA Region IX Preliminary Remediation Goals (PRG) for Industrial Soil (EPA 2004);
  - ODEQ Risk-based Concentrations (RBC) for Soil Ingestion, Dermal Contact, and Inhalation, Occupational Receptor Scenario (ODEQ 2007); and
  - ODEQ Level II Screening Level Values (SLV) for Plants, Invertebrates, and Wildlife (the lowest value was used, ODEQ 2001).

4.1 Human Health Risk Assessment Summary

- Small pile of debris (sample BD1-RT-C):
  - The reported concentration of arsenic (4.6 mg/kg) exceeded the EPA PRG of 1.6 mg/kg, and the ODEQ RBC of 1.7 mg/kg.
  - The risk screening results indicate a low risk to human receptors from exposure to soil from the small pile of debris at the work camp.
- Large pile of debris (sample BD2-RT-C):
  - The reported concentration of arsenic (16.3 mg/kg) exceeded both the EPA Region IX RSL of 1.6 mg/kg and the ODEQ RBC of 1.7 mg/kg.
  - The reported concentration of lead (1,130 mg/kg) exceeded the EPA PRG and the ODEQ RBC, both of which are 800 mg/kg, as well as the BLM RMC for the camper scenario (1,000 mg/kg).
  - The risk screening results indicate a low risk to human receptors from exposure to soil from the large pile of debris at the work camp.
- Soil from around the leaking 55-gallon drum (sample DS1-RT-G):
  - The reported concentration of naphthalene (610 mg/kg) exceeded the ODEQ RBC of 22 mg/kg.
  - The reported concentration of diesel (3,190 mg/kg) was well below the ODEQ RBC of 70,000 mg/kg (ODEQ 2008).
  - The risk screening results indicate a low to moderate risk to human receptors from exposure to soil from around the leaking 55-gallon drum at the work camp.

4.2 Ecological Risk Assessment Summary

- Small pile of debris (sample BD1-RT-C):
  - The reported concentration of barium (141 mg/kg) exceeded the ODEQ SLV of 85 mg/kg.
  - Arsenic and lead pose a moderate risk to the robin.
  - The risk screening results indicate a moderate risk to ecological receptors from exposure to soil from the small pile of debris at the work camp.
- Large pile of debris (sample BD2-RT-C):
  - The following metals exceeded their respective ODEQ SLVs: barium, cadmium, mercury, and lead.
  - Arsenic poses a moderate risk to the robin.
  - Cadmium poses a high risk to the robin and a moderate risk to the deer mouse, mule deer, and elk.

    - Lead poses an extremely high risk to the robin, a high risk to the mule deer, and a moderate risk to the deer mouse and the elk.
    - Mercury poses a moderate risk to the deer mouse and the robin.
    - The risk screening results indicate a moderate to extremely high risk to ecological receptors from exposure to soil from the large pile of debris at the work camp.
- Soil from around the leaking 55-gallon drum (sample DS1-RT-G):
    - The following metals exceeded their respective ODEQ SLVs: barium, naphthalene, and o-xylene.
    - The risk screening results indicate a low risk to ecological receptors from exposure to soil from around the leaking 55-gallon drum at the work camp.

5.0 SUMMARY AND CONCLUSIONS

- Analytical results from the field investigation indicate:
    - Concentrations of metals in soils around the two piles of debris are above federal and state screening criteria.
        - The elevated concentrations of cadmium and lead reported in the sample from the large pile of debris are likely to be from the abandoned car batteries that were observed in the pile.
    - Concentrations of barium, naphthalene, and o-xylene in the soil around the leaking 55-gallon drum are above federal and state screening criteria.
    - The fluid leaking from the 55-gallon drum is likely to consist of creosote.
    - The fluid in the 55-gallon drum labeled "76 Marok" contained a concentration of oil and grease (as HEM) of 131.0 mg/L.
- There appears to be a low risk to human receptors from soils around the two piles of debris and a low to moderate risk to human receptors from soils around the leaking 55-gallon drum.
- There appears to be a moderate risk to ecological receptors from soil around the small pile of debris and the leaking 55-gallon drum and a moderate to extremely high risk to ecological receptors from exposure to soil from the large pile of debris.
    - However, because of the small area of the work camp, the ecological risks are limited to individual receptors rather than at the population level.
- Based on the results of this field investigation, MSE recommends performing a removal action at the work camp to remove the:
    - Leaking 55-gallon drum of creosote;
    - 55-gallon drum labeled "76 Marok";
    - Metals-contaminated soils around the two piles of debris;
    - Creosote-affected soil around the leaking 55-gallon drum; and
    - Abandoned car batteries and electrical insulators.

REFERENCES

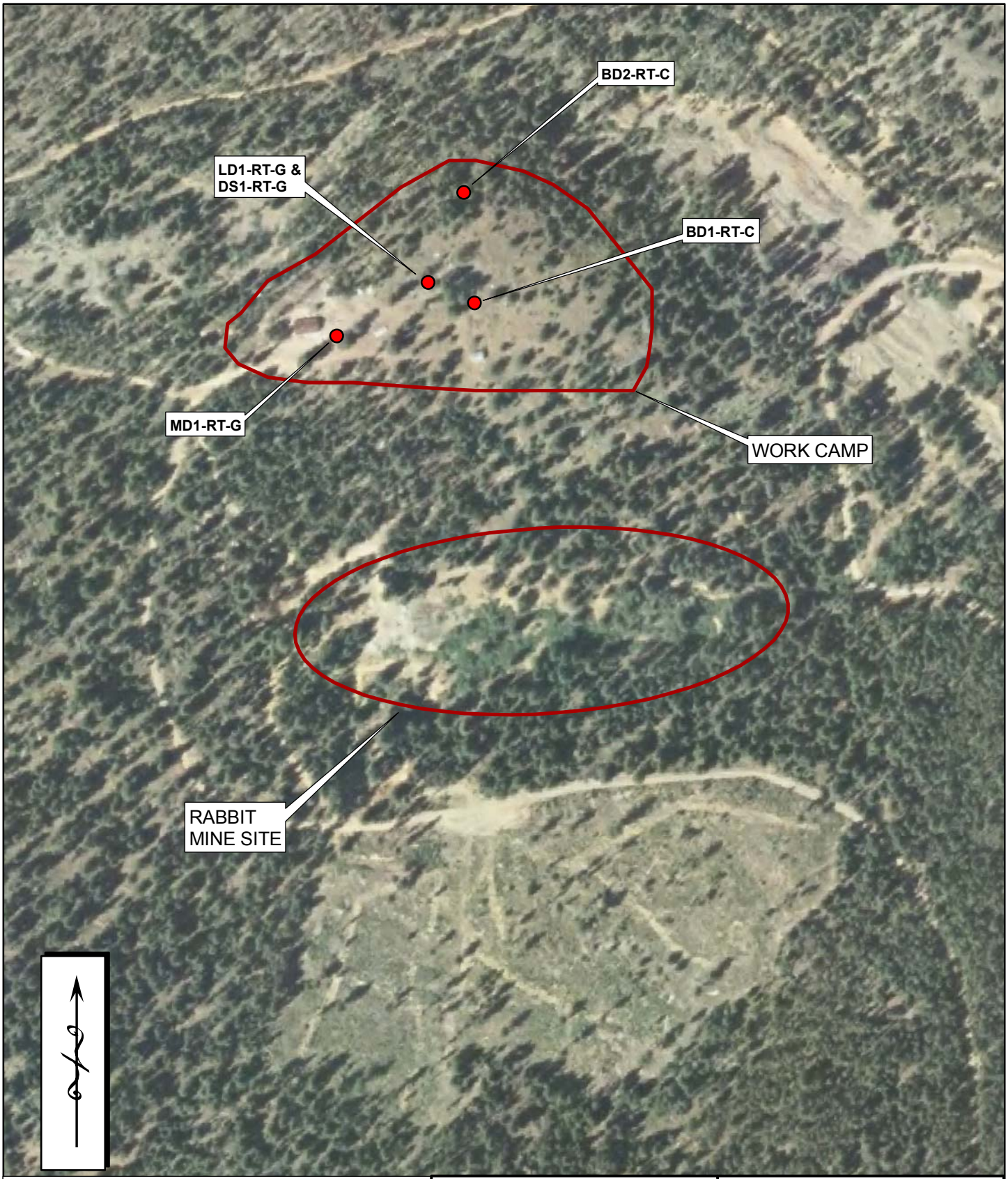
Ford, Karl F. 2004. *"Risk Management Criteria for Metals at BLM Mining Sites."* Denver, Colorado: Bureau of Land Management Technical Note 390 (revised). December.

Oregon Department of Environmental Quality (ODEQ). 2001. "*Guidance for Ecological Risk Assessment."* Waste Management and Cleanup Division. December.

ODEQ. 2007. "Risk-based Concentrations (RBC) for Individual Chemicals." Online address: http://www.deq.state.or.us/lq/rbdm.htm

U.S. Environmental Protection Agency (EPA). 2004. Region IX Preliminary Remediation Goals. Online address: http://www.epa.gov/region09/waste/sfund/prg/

FIGURES



Sample Locations

0 150 300 Feet

1 inch = 200 feet

MSE Millennium Science & Engineering, Inc.
1555 Shoreline Dr. Ste. 150
Boise, ID 83702 USA
Phone: (208) 345-8292

Work Camp Sample Locations

B2473.H	rabbit_campsite.mxd	11/12/08	Figure 1

:MSE\puettl\pyx_rabbit\rabbit_campsite.mxd 11.12.08

TABLES

TABLE 1
Sample Summary
Work Camp Investigation

Medium	Description	Number of Samples	Sample ID	Laboratory Analysis[(a)]
Leaking 55-gal drum	Fluid in drum	1 Grab	LD1-RT-G	PCBs, VOCs, SVOCs, oil & grease
	Soil around drum	1 Grab	DS1-RT-G	TPH, 8 RCRA metals[(b)], VOCs, TCLP
76 Marok 55-gal drum	Fluid in drum	1 Grab	MD1-RT-G	VOCs, oil & grease
Small pile of debris	Soil	1 Composite	BD1-RT-C	TPH, 8 RCRA metals[(a)], VOCs, TCLP
Large pile of debris	Soil	1 Composite	BD2-RT-C	TPH, 8 RCRA metals[(a)], VOCs, TCLP

Notes:
[a] PCBs by EPA Method 8082, VOCs by EPA Method 8260B, SVOCs by EPA Method 8270C, oil & grease by EPA Method 1664, 8 RCRA metals by EPA Method 6010, TPH by EPA Method 8015B Mod., TCLP by EPA Method 8270C
[b] 8 RCRA metals = antimony, beryllium, cadmium, chromium, copper, nickel, silver, and zinc.
PCB = Polychlorinated biphenyl
SVOC = Semi-volatile organic compound
TCLP = Toxicity Characteristic Leaching Procedure
TPH = Total petroleum hydrocarbon
VOC = Volatile organic compound

TABLE 2
Soil Sample Analytical Results Summary
Work Camp Investigation

Sample ID	BD1-RT-C	BD2-RT-C	DS1-RT-G	Background Soil UCL_{90} Concentration, Rabbit Mine	Screening Criteria (mg/kg)		
Sample Description	Soil around small pile of debris	Soil around large pile of debris	Soil around leaking drum		EPA Region IX Industrial Soil Preliminary Remediation Goals (HH)[a]	ODEQ Risk-Based Concentrations (HH)[b]	ODEQ Level II Screening Level Values (ECO)[c]
Date Collected	6/20/2008	6/20/2008	6/20/2008	7/1/2008			
Analyte	Concentration (mg/kg)						
Arsenic	4.6	16.3	*1.25*	3.4	1.6	1.7	NS
Barium	141	603	120	NA	67,000	NS	85
Cadmium	*0.10*	26.1	*0.10*	0.86	450	510	4
Chromium	34.0	38.6	35.2	42.4	450	180 (CrVI)	NS
Mercury	0.078	5.85	0.058	0.041	310	310	0.1
Lead	14.3	1130	4.51	4.88	800	800	16
Selenium	*2.0*	*2.0*	*2.0*	*2.0*	5,100	NS	1
Silver	*0.25*	*0.25*	*0.25*	*0.25*	5,100	5,100	2
Naphthalene	*0.0025*	*0.0025*	610	NA	NS	22	10
Styrene	*0.0025*	*0.0025*	5.99	NA	1,700	NS	300
1,2,4-Trimethylbenzene	*0.0025*	*0.0025*	11.6	NA	170	1,600	NS
1,3,5-Trimethylbenzene	*0.0025*	*0.0025*	2.65	NA	70	1,500	NS
m+p-Xylene	*0.0025*	*0.0025*	9.12	NA	420 (total xylenes)	24,000 (total xylenes)	100 (total xylenes)
o-Xylene	*0.0025*	*0.0025*	5.28	NA	420 (total xylenes)	24,000 (total xylenes)	1
Diesel	*12.5*	*12.5*	3,190	NA	NS	70,000	NS
Lube Oil	125	105	2,000	NA	NS	NS	NS

Notes:
[a]EPA Preliminary Remediation Goals (PRG), Industrial Soil (EPA 2004).
[b]Oregon Risk-Based Concentrations for Soil Ingestion, Dermal Contact, and Inhalation, Occupational Receptor Scenario (ODEQ 2007).
[c]ODEQ Guidance for Ecological Risk Assessment, Level II Screening Level Values for Plants, Invertebrates, and Wildlife (Lowest value, ODEQ 2001).
Italicized indicates result below laboratory reporting limit (RL), reported at 1/2 RL.
Result exceeds screening criteria.
ECO = Ecological
EPA = U.S. Environmental Protection Agency
HH = Human health
NA = Not analyzed for
ODEQ = Oregon Department of Environmental Quality
mg/kg = Milligram per kilogram

TABLE 3
Toxicity Characterization Leaching Procedure Results Summary
Work Camp Investigation

Sample ID	BD1-RT-C	BD2-RT-C	DS1-RT-G	RCRA TCLP Disposal Limit (mg/L)
Sample Description	Soil around small pile of debris	Soil around large pile of debris	Soil around leaking drum	
Date Collected	6/20/2008	6/20/2008	6/20/2008	
Analyte	Concentration (mg/L)			
Arsenic	*0.025*	*0.025*	*0.025*	5
Barium	*0.50*	3.05	*0.50*	100
Cadmium	*0.005*	0.146	*0.005*	1
Chromium	*0.025*	*0.025*	*0.025*	5
Lead	*0.0250*	2.05	*0.0250*	5
Mercury	0.0004	*0.0001*	0.0003	0.2
Selenium	*0.025*	*0.025*	*0.025*	1
Silver	*0.025*	*0.025*	*0.025*	5
pH (S.U.)	4.92	5.30	4.93	NS

Notes:
Italicized indicates result below laboratory reporting limit (RL), reported at 1/2 RL.
NS = No standard
RCRA = Resource Conservation and Recovery Act
S.U. = Standard units
TCLP = Toxicity Characteristic Leaching Procedure
mg/L = Milligram per liter

TABLE 4
Drum Fluids Analytical Results Summary
Work Camp Investigation

Sample ID	MD1-RT-G	LD1-RT-G
Sample Description	76 Marok 55-gal drum	Leaking 55-gal drum
Date Collected	6/20/2008	6/20/2008
Analyte	Concentration (mg/L unless otherwise noted)	
1,2,4-Trimethylbenzene	*0.005*	0.787
1,3,5-Trimethylbenzene	*0.005*	0.199
1-Methylnaphthalene	NA	3.65
2,4-Dimethylphenol	NA	1.01
2-Methylnaphthalene	NA	6.11
2-Methylphenol	NA	0.592
3+4-Methylphenol	NA	1.28
Acenaphthene	NA	0.487
Acenaphthylene	NA	4.55
Anthracene	NA	2.6
Benzene	*0.005*	0.39
Benzo(ghi)perylene	NA	0.674
Benzo[a]anthracene	NA	1.86
Benzo[a]pyrene	NA	1.57
Benzo[b]fluoranthene	NA	0.882
Benzo[k]fluoranthene	NA	1.18
Carbazole	NA	0.721
Chrysene	NA	1.94
Dibenzofuran	NA	2.39
Ethylbenzene	*0.005*	0.118
Fluoranthene	NA	4.03
Fluorene	NA	3.7
Hexane Extractable Material (HEM)	131.0	~100%
Indeno[1,2,3-cd]pyrene	NA	0.702
Naphthalene[a]	0.0129	67.2
Phenanthrene	NA	6.78
Phenol	NA	0.594
Pyrene	NA	4.34
Styrene	*0.005*	1
Toluene	*0.005*	1.37
m,p-Xylene	*0.005*	1.61
o-Xylene	*0.005*	0.635

Notes:
Only constituents detected above the laboratory reporting limit (RL) in at least one sample are reported.
[a] Naphthalene results by EPA method 8260B.
Italicized indicates result below RL, reported at 1/2 RL.
EPA = U.S. Environmental Protection Agency
NA = Not analyzed for

TABLE 5
BLM Risk Management Criteria Screening
Work Camp Investigation

Media and Receptor	Contaminant of Interest (mg/kg)					
	As	Cd	Pb	Hg	Se	Ag
HUMAN HEALTH RISK SCREENING						
Soil around leaking 55-gallon drum (DS1-RT-G)	***1.25***	***0.10***	**4.51**	**0.058**	***2.0***	***0.25***
Camper RMC	20	70	1000	40	700	700
Soil around small debris pile (BD1-RT-C)	**4.6**	***0.10***	**14.3**	**0.078**	***2.0***	***0.25***
Camper RMC	20	70	1000	40	700	700
Soil around large debris pile (BD2-RT-C)	**16.3**	**26.1**	**1130**	**5.85**	***2.0***	***0.25***
Camper RMC	46	155	1000	46	774	774
ECOLOGICAL RISK SCREENING						
Soil around leaking 55-gallon drum (DS1-RT-G)	***1.25***	***0.10***	**4.51**	**0.058**	***2.0***	***0.25***
Deer Mouse RMC	230	7	142	2	NA	NA
Mule Deer RMC	200	3	106	9	NA	NA
Elk RMC	328	3	127	11	NA	NA
Robin RMC	4	0.3	6	1	NA	NA
Soil around small debris pile (BD1-RT-C)	**4.6**	***0.10***	**14.3**	**0.078**	***2.0***	***0.25***
Deer Mouse RMC	230	7	142	2	NA	NA
Mule Deer RMC	200	3	106	9	NA	NA
Elk RMC	328	3	127	11	NA	NA
Robin RMC	4	0.3	6	1	NA	NA
Soil around large debris pile (BD2-RT-C)	**16.3**	**26.1**	**1130**	**5.85**	***2.0***	***0.25***
Deer Mouse RMC	230	7	142	2	NA	NA
Mule Deer RMC	200	3	106	9	NA	NA
Elk RMC	328	3	127	11	NA	NA
Robin RMC	4	0.3	6	1	NA	NA

Notes:
< RMC = low risk
1 to 10X RMC = moderate risk
10 to 100X RMC = high risk
> 100X RMC = extremely high risk
BLM = U.S. Bureau of Land Management
NA = Not applicable
RMC = Risk management criteria
mg/kg = Milligram per kilogram

ATTACHMENT A

SITE PHOTOGRAPHS

Photo 1: Small pile of debris (sampling location BD1-RT-C). June 2008.

Photo 2: Large pile of debris (sampling location BD2-RT-C). June 2008.

Photo 3: Large pile of debris (looking down the hill). June 2008.

Photo 4: Leaking 55-gallon drum and outline of visible surface soil staining (soil sample DS1-RT-C). October 2007.

Photo 5: Leaking 55-gallon drum (fluid sample LD1-RT-G). October 2007.

Photo 6: Abandoned 55-gallon drum labeled "Marok 76" (fluid sample MD1-RT-G). June 2008.